Assessment of the Results of External Independent Reviews for U.S. Department of Energy Projects

Committee on Assessing the Results of External Independent Reviews
for U.S. Department of Energy Projects

Board on Infrastructure and the Constructed Environment
Division on Engineering and Physical Sciences
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Acknowledgment of Reviewers

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

Philip R. Clark, GPU Nuclear Corporation (retired),
David N. Ford, Texas A&M University,
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Michael L. Telson, University of California.

Although the reviewers listed have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Harold K. Forsen, retired senior vice president, Bechtel Corporation. Appointed by the National Research Council, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

Contents

Summary

Peer review is an essential component of engineering practice and other scientific and technical undertakings. Peer reviews are conducted to ensure that activities are technically adequate, competently performed, and properly documented; to validate assumptions, calculations, and extrapolations; and to assess alternative interpretations, methodologies, acceptance criteria, and other aspects of the work products and the documentation that support them. Effective peer reviews are conducted in an environment of mutual respect, recognizing the contributions of all participants. Their primary objective is to help the project team achieve its goals. Reviews also contribute to quality assurance, risk management, and overall improvement of the management process.

The U.S. Department of Energy (DOE) conducts different types of peer reviews at the different stages of a project, including reviews to assess risks and other factors related to design, safety, cost estimates, value engineering, and project management. Independent project reviews (IPRs) are conducted by federal staff not directly affiliated with the project or program and management and operations (M&O) contractors. External independent reviews (EIRs) are overseen by the Office of Engineering and Construction Management (OECM) and conducted by contractors external to the department. EIRs are the primary focus of this report. However, the committee found that, in many cases, IPRs are explicitly used as preparation for or as preliminary reviews prior to EIRs. Thus, because IPRs are integral to the review process in DOE, they are also discussed because they might have an effect on EIRs.

In October 2000, DOE issued Order 413.3, *Program and Project Management for the Acquisition of Capital Assets* (DOE, 2000). The order established a series of five critical decisions (CDs), or major milestones, that require senior management review and approval to ensure that a project satisfies applicable mission, design, security, and safety requirements:

- CD-0 Approve mission need
- CD-1 Approve alternative selection and cost range
- CD-2 Approve performance baseline
- CD-3 Approve start of construction
- CD-4 Approve start of operations or project closeout

Each CD milestone marks an increase in the commitment of DOE resources and requires successful completion of the preceding phase. The order also required a variety of internal and external peer reviews prior to CD approvals, including EIRs and IPRs.

That order made DOE's Office of Engineering and Construction Management (OECM) responsible for overseeing EIRs for all projects with total project costs (TPCs) greater than $5 million before CD-2. For projects with TPCs greater than $400 million (major systems, MS), EIRs are also required before CD-3.

Order 413.3 assigned responsibility for conducting IPRs to the program secretarial offices (PSOs) and gave the PSOs the option of determining when IPRs should be conducted.

A revised order (O 413.3A), issued on July 28, 2006 (DOE, 2006), raises the threshold for the TPC of projects that require an EIR before CD-2 to $100 million and the TPC of major systems that require an EIR before CD-3 to $750 million. The revised order requires the PSOs to conduct IPRs (as opposed to EIRs overseen by the OECM) prior to CD-2 for projects with a TPC less than $100 million.

The DOE has a portfolio of construction and environmental remediation projects valued at more than $205 billion. Some projects are highly complex, one-of-a-kind undertakings. The success of these projects depends on the effective management of risk during the acquisition, conceptual planning, design, and construction processes. Congress continues to support the OECM's oversight of project management practices at the DOE and the use of EIRs to validate project performance baselines. Secretary of Energy Samuel W. Bodman has reiterated the importance of a disciplined project management process and adherence to established processes. Budgetary pressures also make it necessary for the OECM to ensure that EIRs are effectively planned and efficiently executed and that they provide added value to individual projects and the department.

STATEMENT OF TASK

Accordingly, DOE asked the National Research Council (NRC) to appoint an expert committee to advise the department on how EIRs can be tailored to a mix of project types to ensure that:

- Essential information about project scope, cost, feasibility, and risk is provided at the optimum point in DOE's critical decision process;
- DOE's resources (time, staff, funding) are focused on those projects with the greatest risk; and
- EIRs are cost effective.

The committee was also asked to identify lessons learned from its EIR analysis that could be used to refine departmental guidance and policies to further support DOE's goal of continuous improvement in project management.

CONCLUSIONS

There appears to be universal agreement among DOE staff, M&O contractors, and EIR contractors that projects benefit from the effort expended in preparing for EIRs and IPRs. This does not imply that there is concurrence on all aspects of the timing, cost, and comprehensiveness of specific reviews, but the concept of reviewing projects is considered to have value and to benefit the individual projects and DOE. This benefit increases as the size, complexity, and inherent risks of the project increase.

DOE policies designate EIRs as the primary process for validating project cost and schedule baselines prior to submitting funding requests to Congress. The Committee (see Appendix A for biographies of committee members) examined a sample of 26 EIR reports (Appendix B) for 19 projects chosen to be representative of the 150 EIRs conducted between 2000 and 2005. The committee found them to be an effective record of the reviews and an effective vehicle for communicating the review teams' findings and recommendations. At a June 2006 workshop conducted by the committee (Appendix C) DOE project directors and program managers reported additional benefits such as professional development, management process improvement, transfer of lessons learned from other sites and projects, and improved communication between DOE staff and contractor personnel.

If EIRs are intended only to validate project baselines, then the current review planning procedures, the practice of employing outside contractors responding directly to the OECM, and the use of a standardized set of key review elements might be appropriate. However, the value and cost-effectiveness of EIRs would be enhanced if they were (1) planned more carefully with the broader involvement of all stakeholders, (2) tailored in a more flexible manner using a collaborative process, and (3) integrated into the complete portfolio of peer reviews that are used to monitor and support DOE

projects. In addition, EIR reports can be a source of information to improve project management processes and provide valuable lessons for other projects throughout the DOE.

FINDINGS

Finding 1: DOE employs a variety of peer reviews to assess risk and other factors that bear on design, safety, cost estimates, value engineering, and project management. Because the responsibility for organizing the reviews is dispersed throughout the department, the planning of project reviews is not well coordinated.

Finding 2: The value of a peer review (IPR or EIR) depends, in large part, on the experience and expertise of the review team, its capacity to understand the requirements of the project, its independence, and its ability to make objective assessments and recommendations. Assembling teams that have both expertise and independence can be difficult, especially for the complex, one-of-a-kind projects sometimes undertaken by DOE.

Finding 3: Total project cost is the leading criterion in guiding the planning and scheduling of reviews. Additional criteria may be equally appropriate.

Finding 4: Peer reviews (IPRs or EIRs) conducted prior to approval of mission need (CD-0) and again prior to approval of the alternative selection and cost range (CD-1) could play a valuable role in risk management and quality assurance during front-end project planning. Some projects could probably benefit from annual reviews for quality assurance purposes when the time between critical decision milestones exceeds 1 year.

Finding 5: Problems in communication stemming from the prereview planning process have occurred when an EIR team arrived at a significant finding after the on-site exit briefing but did not relay the finding to DOE staff until delivery of the final report.

Finding 6: The purpose of tailoring is to refine the focus of the EIR to suit the particular characteristics of a project. DOE policies emphasize the need for tailoring, but the committee observed little evidence of effective tailoring.

Finding 7: A clearly defined, systematic process for capturing data from peer reviews along with a system to catalogue, store, and disseminate this information is needed and, if implemented, would greatly enhance the benefits derived from peer reviews.

Finding 8: EIRs and other peer reviews are an intrinsic part of project management and are an integral part of project costs. The current policy of funding EIRs from program direction funds places them in competition with other program activities.

RECOMMENDATIONS

Recommendation 1: EIRs should be integrated into a comprehensive peer review process. To accomplish this,

- A comprehensive plan to coordinate the planning for all project peer reviews should be developed by the integrated project team (IPT), with input from the OECM and the PSOs. Plans for peer reviews should be included in the project execution plan and the quality assurance program.

- The IPT, the PSOs, and the OECM should determine the types of and schedules for these reviews using the guidelines shown in Table S-1. It is important to note that the committee's recommendations for reviews to be conducted by default do not necessarily parallel Order 413.3A.
- In addition to the TPC, the criteria for determining the appropriate type, form, and timing of a review should include project complexity; severity and types of inherent risks; project management maturity; and the qualifications and experience of the project teams. These criteria should be developed jointly by the OECM and the PSOs.
- EIRs should be planned and executed jointly by the OECM, the PSOs, and the IPTs. The office responsible for validating the performance baseline (CD-2) should take the lead for reviews that occur prior to CD-2.
- For projects with TPCs less than $100 million, an EIR should be required to validate the performance baseline (CD-2) unless project complexity, inherent risks, project management capabilities, or other factors warrant conducting an IPR. The determination of the most appropriate type of review should be made by the PSO.
- For some projects, a review (IPR or EIR) should be conducted prior to CD-0 and then again prior to CD-1 if warranted by the project complexity, inherent risks, project management capabilities, or other factors. After CD-2, when the elapsed time between critical decision milestones exceeds 1 year, an annual IPR should be conducted for quality assurance purposes.

Recommendation 2: EIRs should assess whether the particular project management team— i.e., project manager, project team, federal project director, and IPT—has the ability to execute the project successfully. This assessment should evaluate the qualifications and experience of the project management team, the project's organizational structure, and the communication and decision-making processes in place.

Recommendation 3: EIR review teams should be selected to provide the experience and expertise necessary to evaluate a project's baseline cost, schedule, scope, inherent risks, and the capabilities of the project management team. The acquisition executive could add DOE contractor personnel who are not project advocates to EIR teams when outside technical expertise is not available. In the long term, the distinction between the EIR and IPR review teams can be lessened and review team members from within DOE and external to it can be selected as needed to address the critical issues presented by each project.

Recommendation 4: The OECM, the PSOs, and the IPT should collaborate on the tailoring of reviews. They should determine which key review elements should be emphasized and which ones should be streamlined based on their assessment of project risks, complexity, and cost.

Recommendation 5: Communication among all EIR participants should be improved from initial planning of the reviews through taking corrective actions:

- If significant findings are arrived at subsequent to the formal on-site exit briefing, the EIR team should notify the IPT immediately and not wait until delivery of the final report.
- Postreview assessments of the quality of the review process for EIRs should be conducted and led by the OECM with input from the IPT and the PSO. The purpose is to improve future reviews and provide input to the annual contractor performance appraisal.

TABLE S.1 Recommended Guidelines for Planning Peer Reviews.

Project Size/TPC	Project Phase				
	Prior to CD-0	Prior to CD-1	Prior to CD-2	Prior to CD-3	Prior to CD-4
Small, TPC $5 million to $20 million	Nothing— unless **, then IPR	IPR—	EIR— unless *, then IPR	IPR—	Nothing— unless **, then IPR
Intermediate, TPC $20 million to $100 million	IPR—	IPR—	ÉIR— unless *, then IPR	IPR— unless **, then EIR	Nothing— unless **, then IPR
Large, - TPC $100 million to $750 million	IPR— unless **, then EIR	IPR— unless **, then EIR	IPR and EIR— sequential or simultaneous **	IPR— unless *,* then EIR	IPR— annual until CD-4
Major system, TPC >$750 million	IPR— unless **, then EIR	IPR— unless **, then EIR	IPR and EIR— sequential or simultaneous ** Annual IPR until CD-3—	IPR and EIR— sequential or simultaneous **	IPR— annual until CD-4

—	Default - review required
*	Review **to be used by** default **unless** project complexity, inherent risks, project management team capabilities or other factors warrant conducting a different type of review — Determination by OECM
**	Review **to be used by** default **unless** project complexity, inherent risks, project management team capabilities or other factors warrant conducting a different type of review — Determination by PSO

Recommendation 6: The DOE should document lessons learned from peer reviews and disseminate them throughout the department.

- The OECM should establish a process to document and disseminate the lessons learned from all peer reviews across all program offices. The process should be developed through a coordinated effort with the full participation of the PSOs.
- EIRs should clearly identify best practices observed in order to facilitate the lessons learned process.

Recommendation 7: DOE should view peer reviews as an intrinsic component of project management.

- The costs for EIRs and IPRs should be covered by project funding—that is, be part of the preliminary engineering design funds prior to CD-2 and a part of project funds when these funds have become available to the PSO.
- Prereview planning decisions about the most appropriate type of review (EIR or IPR) should be based on full-cost accounting of either type of review.

REFERENCES

DOE (Department of Energy). 2000. Program and Project Management for the Acquisition of Capital Assets (Order O 413.3). Washington, D.C.: Department of Energy.

DOE. 2006. Program and Project Management for the Acquisition of Capital Assets (Order O 413.3A). Washington, D.C.: Department of Energy.

1
Introduction

Peer review is an essential component of the practice of engineering and other scientific and technical undertakings. A documented critical assessment of a technical work product, or "peer review", is conducted by a qualified individual or group that is independent of those who performed the work but individually or collectively equivalent in technical expertise to them (NRC, 1997). Peer reviews are conducted to ensure that activities are technically adequate, competently performed, and properly documented; to validate assumptions, calculations, and extrapolations; and to assess alternative interpretations, methodologies, acceptance criteria, and other aspects of the work products and the documentation that supports them.

The U.S. Army Corps of Engineers, the Department of the Interior, and the National Aeronautics and Space Administration routinely use peer review for large engineering projects. The American Society of Civil Engineers (ASCE) promotes peer review as an additional factor that can increase confidence in the design of an engineering project and assure its quality (ASCE, 2004). ASCE describes peer review as an activity that should be used (1) when a project is critical to the public health, safety, and welfare; (2) where reliability of performance under emergency conditions is critical; (3) when the project uses innovative materials or techniques; (4) when it lacks redundancy in design; or (5) where the project's construction sequencing is unique. ASCE recommends that reviews address a defined scope, as set forth by the initiating party, and that project peer review take place throughout the design process. Such reviews should be performed by independent teams or individuals not associated with the original design team.

Although it is rare that an individual or a team can identify all the flaws in its own work, there is often resistance to outside criticism (Weigers, 2006). Peer review can overcome this resistance by operating in an environment of mutual respect and recognizing the contribution and accomplishments of all participants. The review assesses the project team's capacity to complete the project as planned. Its primary objective is to help the project team to achieve its goals, not to be an oversight or audit function.

Various forms of peer review can be undertaken at any phase of a project. Common to all is the need for them to be conducted by qualified and unbiased people who are independent of the project team. The people can come from within the organization or outside it as long as they are sufficiently detached from funding considerations or other interests to ensure that their review is objective (NRC, 1998a). The project team, senior management, or other key stakeholders can initiate reviews.

The Department of Energy (DOE) conducts different types of peer reviews at different stages of a project. Independent project reviews (IPRs) are conducted by federal staff not directly affiliated with the project or program and management and operations (M&O) contractors. External independent reviews (EIRs) are overseen by the Office of Engineering and Construction Management (OECM) and conducted by contractors external to the department. EIRs are the primary focus of this report. However, the committee found that, in many cases, IPRs are explicitly used as preparation for or as preliminary reviews prior to EIRs. Thus, because IPRs are integral to the review process in DOE, they are also discussed where they might have an effect on EIRs.

BACKGROUND OF EXTERNAL INDEPENDENT REVIEWS AT THE DEPARTMENT OF ENERGY

DOE has a portfolio of construction and environmental remediation projects valued at more than $205 billion. Some are highly complex, one-of-a-kind projects. Individual projects often cost hundreds of millions of dollars and some exceed $1 billion. The success of these projects depends on the effective management of risk and other factors during acquisition, conceptual planning, design, and construction. Because these projects involve large sums of public money and are critical to the national defense, the advancement of science, and protection of the environment, Congress needs to ensure that they are planned and managed effectively.

In 1997, recognizing that DOE projects frequently exceeded their projected costs and schedules, Congress initiated a review of all construction projects started in FY 1998 and construction projects in the conceptual design phase (U.S. Congress, 1997). These reviews evaluated the quality of the technical scope of work, cost estimates, schedules, and supporting data, and critiqued the validity of the proposed costs, scopes of work, and schedules. Congress also directed DOE to arrange for an independent assessment of its overall project management structure and process for identifying, managing, designing, and constructing facilities. DOE asked the National Research Council (NRC) to undertake these studies.

The resulting series of NRC studies recommended both internal and external independent project reviews to verify the mission need for DOE projects, their conceptual designs, the selection of alternatives, and project cost and schedule baselines. The recommendations applied to all projects of more than $20 million total estimated costs (TEC),[1] to less costly projects meeting certain criteria for complexity and risk. The reports recommended a graded (or tailored) process for smaller, routine projects (NRC, 1998b, 1999), identified areas where DOE fell short of best practices for project management, and recommended actions to correct these shortfalls. Congress directed DOE to respond to the NRC recommendations, conduct external independent reviews (EIRs) before obligating construction funds in FY 2000, and formalize a process to ensure that EIRs are implemented (U.S. Congress, 1999).

In response, DOE established the Office of Engineering and Construction Management (OECM) within the Office of the Chief Financial Officer to drive changes in DOE's project management system and establish a strong project management capability (DOE, 1999). The OECM serves as DOE's principal point of contact for project management. It develops policy, requirements, and guidance for the acquisition of capital assets; assists in the planning, programming, budgeting, and execution process for the acquisition of capital assets in coordination with the PSOs and project management support offices (PMSOs); and supports the Office of the Secretary and other senior managers in the critical decision (CD) process and in oversight of the acquisition management office. The OECM is also responsible for establishing, maintaining, and executing an independent review capability and validating the performance baseline for all capital asset projects with a TPC of more than $5 million before projects are included in the DOE annual budget request that is submitted to Congress.

In 2000, Congress directed DOE to identify and document the process to be used to determine which projects require an EIR and at which points in a project the EIRs should be conducted (U.S. Congress, 2000). Congress also continued to support the use of EIRs for all new line-item capital projects. In October 2000, DOE issued Order 413.3 *Program and Project Management for the*

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[1] DOE defines total estimated cost (TEC) as the gross cost of the project, including the cost of land and land rights; engineering, design, and inspection costs; direct and indirect construction costs; and the cost of initial equipment necessary to place the plant or installation in operation. The TEC includes contingencies and can be funded as operating or construction expenses. Since 2000, project engineering and design expenses have not been included in congressionally approved TEC. DOE policy documents reference the total project cost (TPC), which consists of all the costs included in the TEC plus the preconstruction costs, such as conceptual design and research and development, as well as the costs associated with the preoperational phase, such as training and startup costs (DOE, 2000a).

Acquisition of Capital Assets (DOE, 2000a), which established a management process organized by phases and critical decisions. The phases represent a logical maturing of broadly stated mission needs into well-defined technical, system, safety, and quality requirements. A series of five critical decisions (CDs) was also established that required senior management to review and approve a project and associated management actions before moving to the next phase of development:

- CD-0 Approve mission need
- CD-1 Approve alternative selection and cost range
- CD-2 Approve performance baseline
- CD-3 Approve start of construction
- CD-4 Approve start of operations or project closeout

The five CDs are major milestones approved by the Secretarial Acquisition Executive or the Acquisition Executive, who must ensure that a project meets applicable mission, design, security, and safety requirements. Each CD marks an incremental commitment of resources by DOE and requires successful completion of the preceding phase or CD. There is no set period of time between CD milestones because projects vary in their complexity, with some taking more time to develop than others.

Collectively, the CDs are intended to affirm the following:

- There is a need that cannot be met through nonmaterial means;
- The selected alternative and approach is the right solution;
- A definitive cost, scope, and schedule baseline has been developed;
- The project is ready for implementation; and
- The project is ready for turnover or transition to operations (DOE, 2003a).

The CD process incorporates a variety of internal and external peer reviews. Table 1-1 is based on DOE policies for project reviews extant during the course of this study. Revisions to these criteria were approved on July 28, 2006, and are discussed in Chapter 3.

The IPRs are managed by the program secretarial offices (PSOs) and the EIRs are managed by the OECM with the support of the PSO and the project teams. Prior to CD-0, there is an option to conduct an IPR focused on the initial planning for the project and development of the mission need statement. Prior to CD-1, an optional IPR may be conducted to focus on the analysis supporting the selection of the preferred alternative to ensure that the system functions and requirements are defined and to confirm the preliminary cost and schedule range.

EIRs are required prior to CD-2 for all projects with a TPC >$5 million to support the OECM's validation of the performance baseline and provide reasonable assurance that the project can be successfully executed. EIRs are also conducted prior to CD-3 for all major system projects to assess their readiness for construction or implementation and to confirm the completeness and accuracy of the performance baselines.

Order 413.3 directs that the CD and EIR processes be tailored to accommodate the project delivery process and characteristics of the project. Referring to the performance baseline review, the order states that "tailoring can apply to any project, but has increased applicability to projects that are considered to be routine in nature . . . .and have relatively low risk. The key requirement for tailoring the Performance Baseline Review is the ability of OECM to validate the Performance Baseline" (DOE, 2003a, p. 9-8).

TABLE 1.1 Types of Project Reviews

Review Title	Accomplished Prior to	Required or Optional	Responsible Organization	Type of Review
Mission need	CD-0	Optional	PSO/deputy administrator	IPR
Alternative selection and cost range	CD-1	Optional	PSO/deputy administrator	IPR
Performance baseline	CD-2	Required	OECM	EIR
Construction or execution readiness	CD-3	Required for major system[a] (MS) project; optional for non-MS projects	OECM for MS projects; PSO for non-MS projects	EIR for MS projects; IPR for non-MS projects

[a] Major systems are projects with a TEC >$400 million.
SOURCE: DOE, 2003a.

The order also delineates a set of key review elements to be covered but allows the level of detail and the effort involved in collecting data on these elements to be tailored to the size, complexity, and inherent risks of a project (DOE, 2003a). EIRs examined in this study included the following elements:

- Work breakdown structure,
- Resource loaded schedule (basis of cost and schedule estimates),
- Key project cost and schedule assumptions,
- Funding profile,
- Critical path,
- Risk management,
- Systems functions and requirements,
- Preliminary design review and comment disposition,
- Basis of preliminary design (review element is limited to major complex projects),
- Hazards analysis,
- Value management/engineering,
- Project controls/earned value management system,
- Project execution plan,
- Start-up test plan,
- Acquisition strategy, and
- Integrated project team.

The OECM is responsible for selecting EIR consultants and planning EIR activities, although the PSO and the integrated project team (IPT)[2] play an active role in the process. Prior to its on-site

[2] Order 413.3 defines Integrated Project Teams as a team of professionals representing diverse disciplines with the specific knowledge, skills, and abilities necessary to support the successful execution of projects. Project directors, contracting officers, safety and quality, legal and personnel in technical disciplines compose the

briefings, the IPT provides relevant project documents to the EIR contractors. The onsite sessions include, in addition to the briefings, discussions among the EIR contractors and the IPT and culminate in a presentation by the contractors of their preliminary findings. This is followed by a written draft EIR that is checked over by the IPT for factual errors. After the EIR is finalized, the IPT prepares a corrective action plan. The EIR's findings and recommendations and the IPT's corrective action plan are used by the OECM to determine the validity of the project's performance baseline and the sufficiency of project management actions needed to move the project to its next phase of development. The project management documentation, EIR report(s), and corrective action plans are used by the OECM to develop recommendations for senior management and acquisition executive actions as input to CD-2 and to help determine whether a project is ready for inclusion in DOE's annual budget request.

Between the release of O 413.3 in October 2000 through FY 2005, the OECM has completed more than 150 EIRs. A 2004 NRC report found that

> The procedures for the congressionally mandated EIRs have matured over time and the reviews are more comprehensive and have improved in quality. Consequently, there is increased appreciation within DOE of the value of EIRs, and DOE project directors interviewed by the committee now acknowledge that EIRs have provided useful information and have added considerable value to the project delivery process. . . . Although many DOE managers recognize the value of EIRs, the committee has heard the opinion voiced by some DOE managers and M&O [management and operation] contractors that external independent reviews provide no added value on projects costing $5 million to $20 million TPC. . . . .
>
> The committee continues to recommend that reviews of all projects should be conducted in some form. The scope and content of the review should be tailored to the complexities and peculiarities of the project, especially for those projects between $5 million and $20 million. . . . .
>
> Independent reviews of plans, assumptions, designs, estimates, and schedules are the accepted standard in industry. In fact, independent reviews are one of the means by which industrial firms become successful at project management and continue to stay that way (NRC, 2002b). The committee strongly advocates that DOE continue to recognize the value of EIRs for improving project performance and expand their application for documenting lessons learned (NRC, 2004, p. 34-35).

Congress continues to support the OECM's oversight of project management practices at DOE and the use of EIRs to validate project performance baselines. An August 2005 memorandum from Secretary of Energy Bodman to the heads of all DOE offices and programs (DOE, 2005) reiterated the importance of a disciplined project management process and adherence to the processes described in O 413.3 and the OECM's *Project Management for the Acquisition of Capital Assets* (DOE, 2003a). Budgetary pressures mean that the OECM must ensure that the EIRs are effectively planned, efficiently executed, and provide added value to DOE and its individual projects.

STATEMENT OF TASK

As recommended in the language of Senate Report 108-115 [212], DOE asked the NRC to appoint an expert committee to advise DOE on how its EIRs can be tailored to a mix of project types to ensure that

- Essential information about project scope, cost, feasibility, and risk is provided at the optimum point in DOE's CD process;

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membership of the typical Integrated Project Team" (DOE, 2003a, p. 3-7). The IPT is led by the federal project director.

- DOE's resources (time, staff, funding) are focused on projects with the greatest risk; and
- EIRs are cost effective.

The committee was also asked to identify lessons learned from the EIR analysis that could be used to refine departmental guidance and policies to further support DOE's goal of continuous improvement in project management.

To accomplish these tasks, the NRC appointed 11 people from industry, government, and academia. Collectively the committee members have expertise and experience in project management; civil engineering; facilities design and construction; risk management; environmental engineering; project delivery systems; government procurement procedures; project scheduling; cost estimating and analysis; program evaluation; and peer review procedures. Three members of the committee participated in the 2000-2003 oversight and assessment of DOE's project management. One member also served on the first assessment committee (NRC, 1999). Lloyd Duscha, principal investigator of *Assessing the Need for Independent Project Reviews in the Department of Energy* (NRC, 1998) and a member of subsequent oversight and assessment committees, served as a consultant to the committee that wrote this report. Biographical sketches are presented in Appendix A.

STUDY PROCESS

The committee met three times and reviewed more than 70 project-specific and policy documents of the DOE. The first meeting, convened February 27-28, 2006, included briefings on policies and procedures and specific issues of interest to the OECM and the PSOs. The committee, with input from OECM staff, identified 19 projects chosen to be representative of the 150 EIRs conducted between 2000 and 2005. Project performance records (baseline performance according to the February 2006 report to the DOE deputy secretary) were available for each project. The selected projects represent a range of size and cost (small, <$20 million; medium, $20 to $100 million; and large, >$100 million), the major PSOs (National Nuclear Security Administration [NNSA], Office of Science [SC], and Office of Environmental Management [EM]), and each of the EIR contractors. The project sample was not randomized in a statistical sense. The projects and project-specific documents are listed in Appendix B. The committee also reviewed EIR reports prepared by contractors, DOE corrective action plans, related project correspondence, and engaged in telephone conferences with selected project directors to gain further insight into the written record.

The second meeting, convened June 7-9, 2006, included a workshop with DOE staff from headquarters and field offices of the OECM, the NNSA, the SC, and the EM; M&O contractors; and EIR contractors, who discussed the issues identified by the committee that influence the planning, execution, and outcome of EIRs. Workshop participants are listed in Appendix C, where the discussions are summarized as well.

At its third meeting, held July 25-26, 2006, the committee synthesized and analyzed the information it had gathered and developed its findings and recommendations. The recommendations, which are based, in part, on lessons learned from its EIR analysis, represent refinements to current departmental guidance and policies. The committee's report underwent a peer review according to NRC procedures to ensure that the conclusions, findings, and recommendations were supported by the information presented.

ORGANIZATION OF THE REPORT

This report is organized in four chapters and three appendixes that contain supporting information. Chapter 1, "Introduction," provides background information.

Chapter 2, "Characteristics of Effective External Independent Reviews," also discusses how the results of EIRs are used. The committee describes its expectations for effective review programs in light of its observations of DOE's EIRs and identifies some lessons learned from this review. It covers the benefits of EIRs, the planning process, the independence and expertise of the review teams, the integration of the various types of DOE peer reviews, the costs of such reviews and the impact of where the funding comes from, and using the EIRs to improve overall project management.

Chapter 3, "Criteria for Structuring Review Programs," discusses the policies and procedures for conducting a review program that includes EIRs and other types of peer reviews. It addresses DOE's review structure based on project costs and changes that had been implemented during the course of the study (as of July 28, 2006). Criteria for the timing, assignment of responsibility, and tailoring of reviews are also addressed. The committee presents guidelines for structuring a peer review program based on criteria such as project costs, inherent risks, scope, and schedule, and the capabilities of the project team.

As promised by its title, Chapter 4 contains conclusions, findings, and recommendations. In it, the committee assesses DOE's program for EIRs and related peer reviews, specifically recommending actions to improve the planning of reviews, project team readiness, benefits of reviews, lessons learned from them, coordination of EIRs and IPRs, and their tailoring and funding.

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Characteristics of Effective External Independent Reviews

The foremost purpose of any peer review is to increase the probability of project success. Historically, well-planned and well-conducted peer reviews add value to the project and the sponsoring organization. Not submitting projects to an independent peer review or conducting poorly planned and executed peer reviews can lead to projects that cost too much, take too long to complete, and do not adequately support the owner's missions (NRC, 1998).

Chapter 9 of DOE Manual 413.3-1, *Project Management for the Acquisition of Capital Assets* (DOE, 2003a, p. 9-1), lists the following as key objectives of project reviews:

- Ensure readiness to proceed to a subsequent project phase.
- Ensure orderly and mutually supportive progress of various project efforts.
- Confirm functional integration of project products and efforts of organizational components.
- Enable identification and resolution of issues at the earliest time, lowest work level, and lowest cost.
- Support event-based decisions.
- Control risk.

The manual and Order 413.3 describe various types of reviews that can be used to accomplish these objectives. They include periodic reviews, such as independent project reviews (IPRs) and external independent reviews (EIRs), to assess the status of a project and reviews that address a particular problem or technical issue, such as independent cost or design reviews. Peer review can provide a wealth of information about a project's progress and performance and can communicate that information to a range of stakeholders.

The purpose of DOE peer reviews is determined by the various offices that initiate and conduct them. For example, the integrated project team (IPT) or project management support office (PMSO) in each of three program secretarial offices (PSOs)—the National Nuclear Security Administration (NNSA), the Office of Environmental Management (EM), and the Office of Science (SC)—may initiate an assessment of a particular technology and use its own staff to analyze the data. IPRs are used to identify and look into critical issues before they become serious problems. In this manner a review serves as a tool for risk management and mitigation.

Alternatively, DOE's Office of Engineering and Construction Management (OECM) might oversee an EIR conducted by contractors to assess cost or the estimated schedule to support validation of a project's performance baseline (CD-2). The OECM also oversees EIRs conducted prior to CD-3 for major systems. The main objective of an EIR is to ensure the completeness of front-end project planning and that a project can be managed in accordance with performance baselines. EIRs provide the OECM and senior management with substantive, independent, unbiased assessments of project assumptions and alternatives.

Many individuals and project teams naturally resist reviews of any kind. To overcome this resistance, an organization's culture needs to be molded to look at a review as a means of adding value, not just as an audit or oversight function. Reviews can do many things, not just corroborate baseline costs and schedule estimates. They can improve overall management processes as well as a specific project's performance. In addition to ensuring compliance with policies and procedures, they can assure quality.

Maximizing the value of a review requires all the parties involved to collaborate in tailoring the scope of the review to suit the risks and characteristics of a specific project and to satisfy multiple objectives.

DIVERSE STAKEHOLDERS AND BENEFITS

Currently, EIRs are primarily used to validate a project's performance baseline and to estimate prospects of future performance for various stakeholders, including Congress and the public, DOE's senior managers, the OECM, the PSOs, the federal project director, and the IPT.

Having projects reviewed by outside, independent experts allows DOE managers to present credible evidence to Congress that project funding requests have been carefully analyzed and are well founded. Because peer reviews help to avoid cost overruns and other problems/difficulties/troubles that reflect poorly on government capabilities, they help to assure the public that sound practices are being followed in carrying out agency missions.

DOE senior managers (deputy secretary, under secretaries, program secretarial officers, and deputy administrators) are collectively responsible for all project acquisitions, program and capital asset execution, and implementation of policy. They make decisions, including critical decisions, and conduct quarterly project performance reviews. They use EIRs to help decide if a project can be included in the DOE's annual budget submission to Congress or if construction can be started for major systems projects.

The federal project director is accountable to the acquisition executive or PSO for executing a project and assuring it meets cost, schedule, and performance targets. The director leads the IPT and serves as the single point of contact between federal and contractor staff for all matters relating to the project and its performance.

It is worth noting that while there appears to be universal agreement among DOE staff, M&O contractors, and EIR contractors that projects benefit from the effort expended in conducting peer reviews and that this benefit increases as the size, complexity, and inherent risks of the project increase, there is not necessarily agreement on all aspects of timing, cost, and comprehensiveness of specific reviews.

REVIEW PLANNING PROCESS AND TAILORING

The EIR process is controlled by the OECM and has been implemented by three outside contractors.[1] These independent contractors are tasked with assembling a team of experts with the knowledge and skills appropriate for the project being reviewed, examining project management and design documents, planning and conducting on-site interviews, and reporting on the readiness of the projects to proceed beyond approval of the project performance baseline (CD-2). The EIR manual developed by the OECM provides general guidance for the process (DOE, 2003b). The IPT is responsible for assembling information required by the EIR team, providing on-site briefings, and, eventually, responding to the EIR recommendations.

An EIR is initiated prior to CD-2, when a project's front-end planning should be complete and its scope has been judged to be valid and stable. To produce an effective review, the EIR team must understand the information in a large array of complex documents, the decisions they record, the interaction of these decisions, and their impact on the validity of the project baseline. Transferring and acquiring the necessary understanding of the project requires a significant investment of time by the IPT and the EIR team.

It is the committee's opinion that the current practice of initiating this effort four or five weeks prior to an on-site review and relying on IPT briefings to complete the process is not always efficient or effective. The process could be facilitated by involving some of the external reviewers in IPRs that occur earlier in the project. The objective would be to facilitate the transfer of information across process

[1] The number of contractors was increased to five during the course of this study.

"interfaces" when information is handed off from DOE staff to external contractors. By participating in earlier discussions, the external contractors could hear first hand about potential issues and the discussions surrounding them and thus avoid going over the same ground when the IPT briefs the external contractors. It would also provide a crosscheck to help ensure that significant information does not "fall through the cracks" when the IPT relays information from IPRs to the EIR contractors. The IPRs, in turn, could benefit from the added perspective of fully independent reviewers who might be less constrained than in-house staff or M&O contractors to question planning assumptions.

DOE projects often involve specialized scientific equipment or innovative technologies with significant risks and implementation challenges. The nonroutine, sometimes unique, nature of DOE projects requires a case-by-case treatment. For this reason, EIRs often call for peer reviewers who have unique expertise. In addition, critical issues change over the course of a project's development, with planning issues dominating in the early stages and implementation issues in the later stages. As a result, the composition of a review team must be carefully considered to ensure that members have the appropriate expertise.

The nonroutine characteristics of DOE projects is recognized in DOE policies regarding tailoring which note that an EIR can be tailored to the size, risk, technological readiness, and complexity of the project being reviewed (DOE, 2000, 2003). Tailoring allows for modifying the methodology and approach used to meet EIR requirements and might involve consolidating decisions or process concurrency or other changes. Thus, an EIR for small, routine projects might be streamlined and involve a smaller team, although all key review elements must be addressed.

The committee observed little evidence of effective tailoring for EIRs. Determining how to tailor an EIR requires experience as well as judgment about the value of peer reviews per se. For example, tailoring that involved eliminating the on-site sessions for smaller projects was reported to severely diminish the effectiveness of the EIR. Because much of the value of a peer review lies in the interaction of the participants, it is not surprising that eliminating the on-site review was counterproductive. In contrast, tailoring that was done by a collaboration of the EIR contractor, the IPT, the PSO, and the OECM produced effective reviews. For example, the CD-3 review for the Microsystems and Engineering Science Applications (MESA) project at Sandia National Laboratories conducted by Burns & Roe Enterprises in February 2003 was formulated jointly by the OECM, Burns & Roe, and MESA project personnel.

The timing of peer reviews is also significant. For most projects the practice is to conduct an EIR prior to CD-2 and for major systems another EIR prior to CD-3. However, it may be advantageous to tailor the timing. For quality assurance, some projects could probably benefit from annual reviews when more than 1 year elapses between CDs. Such reviews could provide a fresh look at the project, account for changing circumstances, identify emerging problems, and revisit project assumptions and the information on which decisions were based to ensure they remain valid.

MAINTAINING INDEPENDENCE

Committee members and DOE staff, M&O contractors, and EIR contractors generally agreed that review team members should be independent of the project team. Having reviewers who did not participate in the planning and execution of the project is vital for objectivity and for increasing confidence in decisions on major, complex projects with significant inherent risks.

What constitutes independence, however, is subject to interpretation. In IPRs, independence is generally considered to be achieved by using federal staff or DOE M&O contractors who are not directly associated with the particular project. They may be personnel who work in the same DOE program or at the same site as the project team, personnel who work in other DOE programs and sites, or personnel who have never worked for DOE or one of its contractors or who no longer do.

EIR contractors are external to DOE and not directly associated with the project. However, because only three contracting firms were used prior to 2006, their ongoing relationship with DOE and its

federal staff might compromise their independence. The addition of two firms, for a total of five, should help to mitigate this concern. In general, the more detached a reviewer is from economic, political, social, or other influences, the more independent he or she can be. The need for objectivity is also recognized by private sector firms such as Chevron-Texaco, whose project development and execution process requires totally independent design review boards (NRC, 2002).

Some disagreement was found among DOE staff and contractors regarding the relative value of IPRs and EIRs. Some federal staff believe that EIRs are more effective than IPRs because the participants are more independent and take more trouble to prepare for the reviews and to ensure that project plans and documentation are complete and up to date. Others believed IPRs are preferable to EIRs because external reviewers do not always have the required technical expertise**.**

The committee believes that peer reviews using a mix of internal and external reviewers would best assure independence while providing the necessary expertise.

INTEGRATION OF REVIEWS

Developing a comprehensive plan for EIRs and other peer reviews would give DOE more overall value by creating a continuum of risk management and quality assurance during all phases of project development. Current DOE practices disperse the responsibility for organizing the various types of reviews: contractors manage independent design and technical reviews, PSOs manage IPRs, and OECM manages EIRs. Greater coordination in the planning of reviews could improve the outcomes of all reviews. For example, EIRs and IPRs have been performed simultaneously for some projects. For other projects, they have been scheduled sequentially over time. Conducting reviews simultaneously reduces the time required for briefings and data-gathering interviews. Conducting them sequentially allows DOE to schedule IPRs first to determine if the project is ready for an EIR review to validate the performance baseline. On balance, the committee believes that sequential reviews are preferable because actions can be taken to correct problems identified during the IPR and to ascertain the effectiveness of those corrective actions in a subsequent EIR (the later reviews should be scheduled to allow sufficient time to do these assessments). For all projects, the schedules for EIRs and IPRs should be carefully coordinated to maximize the value of reviews and minimize disruptions to the project.

If EIRs were conducted by the PSOs and the OECM assumed an oversight role it might be expected that the portfolio of reviews will be more coordinated, comprehensive, unbiased, and effective.

COST AND VALUE

Workshop participants indicated that an EIR costs about $150,000 on average. The range of costs is significant, however—from about $50,000 for a small project using a three-person team to as much as $1.2 million for an EIR assessment of a large, complex project.

Currently, EIR costs (travel, contractor salaries, and overhead) are funded by the program direction budgets, which are also used to fund other project management activities. This practice puts pressure on DOE program managers to choose between funding EIRs and funding the training of personnel or other activities to improve project management. By contrast, the only IPR costs requiring direct funding are the travel expenses of the review team, because labor costs are absorbed by the team members' program. Comparing the full costs of EIRs to the partial costs of IPRs results in a bias in favor of IPRs. This bias is reinforced when program managers are required to make trade-offs between EIRs and other important activities.

Analyzing the costs and benefits of EIRs and IPRs is a challenge. A full cost accounting should include labor, travel, and overhead for all review personnel. For EIRs, contract costs can be compared to project costs, but for IPRs, current accounting procedures make only the travel costs easily identifiable. The full costs of federal staff time and overhead cannot be disaggregated.

Quantifying the benefits of peer reviews is also difficult because benefits accrue primarily in the form of problem avoidance and increased confidence in project performance, outcomes that are difficult to quantify. For all these reasons, determining what type of review to conduct and when to conduct it for a particular project based on the costs and benefits is a subjective process.

As already mentioned, the committee sensed agreement among DOE staff and contractors at headquarters and in project offices that EIRs provide value. There was also general agreement that large, complex projects benefit more than small, routine projects. Whether this justifies the cost of EIRs was not clear due to the paucity of easily measured, quantifiable data on costs and benefits.

The committee believes that some indicators of the performance of EIRs should be developed, although care must be taken in doing so. For example, the number of projects that require rebaselining might be an indicator of the effectiveness of the EIR program. However these data are not readily available and are in any case influenced by factors outside the purview of the EIR: The committee observed situations where EIR team recommendations to change the baseline cost and schedule or to make a security- related change were not followed for budgetary or other reasons. Thus, using the number of projects requiring rebaselining as an indicator of the value of EIRs could be misleading because there were no outcomes for the EIR recommendations and nothing could be measured.

This is not to say that useful indicators cannot be developed. The report *Measuring Performance and Benchmarking Project Management at the Department of Energy* (NRC, 2005) provides advice and guidance intended to help DOE develop and implement effective performance measures and an effective benchmarking program for project management. It suggests 30 possible performance measures in four sets: project-level input/process measures; project-level output/outcome measures; program- and department-level input/process measures; and program- and department-level output/outcome measures. The report notes that the "value of an individual performance measure is limited, but combined, the measures provide a robust assessment of the quality of project management for individual projects and programs" (NRC, 2005, p. 1).

The report suggests using corrective actions from IPRs, EIRs and quality assurance reports as a "project-level input/process measure" to assess the resources provided to deliver an individual project and the management of the project against standard procedures. The use of IPRs and EIRs and implementation of corrective action plans is also suggested as a "program- and department-level input/process measure". Such measures are used to assess the total resources provided for all projects within a program or department and the degree to which program- and department-wide goals for projects and their management are met. The report notes that "Independent reviews can alert project directors to potential problem areas that will need to be resolved as well as provide suggestions for handling these problems" (NRC, 2005, p. 17). The measures would be calculated by determining if an EIR was conducted on the project prior to CD-3 and the percent of EIR issues addressed by corrective actions.

By using a set of performance measures, improvements to the EIR process, in conjunction with other management improvements should be visible in the trends for DOE project management performance across projects and over time.

USING PEER REVIEWS TO IMPROVE PROJECT MANAGEMENT CAPABILITIES

Both EIRs and IPRs provide information for making effective decisions about DOE projects. The data developed, recommendations made, and effective practices identified during reviews can also be used to improve the project management process for a particular project by indicating areas that need closer scrutiny or a different approach by the project management team. EIRs also add discipline to the project management process and provide opportunities to increase control of the outcomes. For small projects undertaken by less experienced personnel, EIRs were reported to provide training and contribute to their professional development.

In some instances, especially on smaller projects managed by less experienced personnel, mentoring by individuals on the review panels may be a value-added benefit for the costs and time

invested. EIRs assemble a panel of very experienced and skilled individuals to perform the review and meet with project staff to discuss the content and meaning of various items of project work. Each meeting between the review panel and project personnel is an opportunity to mentor the project team members. If this broader view of peer reviews were to become a part of DOE's management culture, project staff might look forward to the next review to improve themselves rather than to dread them as an audit or an inquisition into their work.

Peer reviews (EIRS and IPRs) can be a primary vehicle for gauging an organization's project management and maturing it. The committee learned that this had happened during reviews, but the efforts were ad hoc and inconsistent from project to project and from program to program. When EIR contractors are exposed to problems and solutions from multiple projects at multiple sites they can disseminate these lessons learned through on-site discussions and EIR reports. DOE staff and M&O contractors who participate in IPRs are exposed to methods and procedures from other sites and bring their experience to benefit the personnel associated with the project being reviewed. However, these benefits have not been documented or measured. NNSA reported that an effort had been initiated to capture lessons learned from IPRs of their projects, but this effort does not apply to EIRs, and the committee found no entity other than NNSA that used such information. A clearly defined, systematic process for documenting data from peer reviews along with a system for cataloging, storing, and disseminating it is needed; if implemented, it would greatly enhance the benefits of peer reviews. The OECM, in collaboration with the PSO and the federal project directors, and with input from contractors, should develop criteria and guidelines for such a system.

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Criteria for Structuring Review Programs

DOE Order O 413.3 established criteria for the timing of peer reviews based on total project cost (TPC) and identified the DOE office responsible for conducting the reviews (Table 1.1). A revised Order, O 413.3A was issued on July 28, 2006. The timing and types of peer reviews and the responsible office remained the same as outlined in Table 1.1. However, the TPC threshold levels that trigger the requirement for an EIR or IPR (not shown on Table 1.1) were changed significantly. The Office of Engineering and Construction Management (OECM) is now required to conduct an external independent review (EIR) prior to CD-2 for a project with a TPC of $100 million or more and prior to CD-3 for a major systems project of $750 million or more (DOE, 2006). The revised Order, 413.3A, requires the program secretarial offices (PSOs) to conduct independent project reviews (IPRs) prior to CD-2 and CD-3 for projects with a TPC less than $100 million. Order 413.3A also addresses the need for IPRs prior to other critical decision (CD) points and for peer reviews of technical design, quality, risk management, and safety.

DOE projects vary significantly in size, complexity, scope, and inherent risk. An analysis of 141 projects in the Project Assessment and Reporting System (PARS) database indicated that the average total project cost was more than $1 billion, whereas the median total project cost was $175 million. The PARS data demonstrate skewing due the small percentage of projects having very high costs. Table 3.1 shows the distribution of the 141 projects by TPC. Although 70 percent of all projects cost less than $750 million each, their combined costs total only 11 percent of all project estimated costs. Considered another way, 30 percent of the total number of DOE projects accounted for 89 percent of total estimated costs. Many of the projects costing more than $750 million are in the Office of Environmental Management.

The committee was asked to advise DOE on how it could focus its resources on those projects with the greatest risk. In the committee's opinion, the distribution of projects at various TPCs and the relative level of risk of the larger projects support Order 413.3A's revised thresholds at which an IPR or an EIR is triggered. However, the committee also believes that more emphasis should be placed on factors other than cost that influence project risk, such as the extent to which a technology was used previously in its planned application, the number of stakeholders and their influence on project requirements, and the certainty and detail in the definition of the project scope.

TIMING OF REVIEWS

DOE policy recognizes the importance of peer reviews for performance baseline validation and prior to the start of construction. The Construction Industry Institute's (CII's) benchmarking program has shown that the quality and completeness of a project's front-end planning affect the probability that a project will succeed and that an owner's best opportunities to influence the outcome of a project occur at the front end (CII, 1996). The more complex and risky a project, the greater the need to ensure the validity of early CDs.

TABLE 3.1 Distribution of sample projects in the Project Assessment and Reporting System

Total Project Cost (million $)	Percentage of Projects (Cumulative) (million $)	Percentage of Costs (Cumulative) (million $)
<20	11	<1
<100	38	2
<400	62	7
<750	70	11

Previous NRC reports focusing on DOE's project management procedures emphasized again and again the importance of effective risk management to the success of projects (NRC, 2001, 2003, 2004). Risk management is important element of EIRs because it is critical to the validation of baseline budgets and schedules. The nature and severity of risks vary greatly from project to project, requiring their review to be closely tailored to specific project needs.

The NRC report *The Owner's Role In Project Risk Management* addresses the role of risk management in DOE projects and supports a proactive approach in which owners take the following actions:

- Start risk management early in the life cycle of all projects, prior to CD-0, approval of mission need.
- Include key stakeholders in the process, with the DOE project director as the lead and the integrated project team (IPT) also intimately involved.
- Evaluate project risks and risk responses periodically during project life (CD-0 through approval of the start of operations [CD-4]).
- Develop risk mitigation plans and update them as the project progresses.
- Follow through with mitigation actions until risks are acceptable.
- Tie a project's level of risk to cost and schedule contingencies.
- Communicate progress and changes to project risks and mitigation plans to all key stakeholders.

The report also noted that risk needs to be managed by qualified personnel working within a project management process that includes review and approval by senior management. CDs, such as those defined in DOE O 413.3, must be made by senior management to ensure the quality of the risk management process and that the risks inherent in a project are necessary and acceptable. Reliance on team experience alone, without subjecting decisions to reviews, can lead to gaps in analysis and lack of consistency (NRC, 2005).

Peer reviews conducted prior to CD-0 and CD-1 could play an important role in risk management and quality assurance. Moreover, since risk can change as a project— especially a large and complex project—develops, some form of periodic peer review is justified. The committee believes, furthermore, that additional reviews should be considered to assure quality if the time elapsing between CDs is greater than 1 year.

RESPONSIBLE OFFICE

DOE Orders 413.3 and 413.3A assign responsibility for project oversight, baseline validation, and control of reviews based on the TPC. The overall result of DOE policies is that the OECM controls EIRs and the PSOs control the IPRs. In the committee's opinion, this distinction is unnecessary and it may hamper the selection of the most appropriate type of review. Depending on the TPC, complexity, and

risks of a project, EIRs could be successfully planned and executed by the PSOs and the project teams. The OECM could then assume an oversight role to ensure that the reviews are adequately planned and executed and that the review teams have the necessary expertise and are sufficiently independent, that is, sufficiently detached from the project to be able to provide objective advice. The office responsible for validating the performance baseline (CD-2) should take the lead for EIRs that occur prior to CD-2. Such an approach would place responsibility for conducting the EIR with the group that is most directly accountable for the project outcome.

TAILORING

DOE Order 413.3 recognizes that the complexity and variations inherent in DOE capital asset projects require a project-by-project adjustment or tailoring of the peer review process (DOE, 2000). The order states that while all key review elements are to be addressed, the approach to meeting the requirements should be consistent with a project's risk, complexity, visibility, cost, safety, security, and schedule. The federal project director is required to develop a tailoring strategy to be approved by the Acquisition Executive.

The parameters for tailoring, such as risk, complexity, visibility, safety, security, cost, and schedule, are influenced by project size, but they are also independent. Although O 413.3 review criteria are based primarily on TPC, peer review team requirements, lines of inquiry, and duration of reviews, depend primarily on the risks inherent in the project and the project management team's ability to control or mitigate those risks.

Considering the benefits to be gained from all types of peer review, DOE procedures should require more extensive and more independent reviews as the default for most projects. Tailoring should be applied to streamline key review elements if project risks are well understood and are minimal. The committee believes that EIRs and IPRs should be considered on a continuum and that reviews should be tailored to provide a balance of independence and expertise specific to the risks and characteristics of the project. As noted in O 413.3, tailoring should be undertaken by the leaders of the project management team, overseen by the Acquisition Executive or the OECM. DOE should seek to instill a culture of unbiased peer review throughout the organization. The OECM could assume an oversight role to ensure that the reviews are unbiased and to address issues critical to the success of the project.

CRITERIA FOR STRUCTURING A PEER REVIEW PROGRAM

Based on its observations, the committee believes the frequency of peer reviews throughout the life of a project, from CD-0 to CD-4, should depend on several factors, including the TPC, project complexity, inherent risks, capabilities of the project management team, and the amount of time elapsing between CDs.

Evaluating technological risk is a problem faced by many business and government agencies. The process for tailoring a peer review to technological risks requires understanding the magnitude of the potential risk. Faced with quantifying the technological risk in a space vehicle design, NASA developed a technological readiness scale (Mankins, 1995) that evaluates risk in each subsystem: The NASA scale ranges from 1 to 9, with 1 indicating that only the basic principles of the technology have been observed and reported and 9 indicating that a system's capabilities have been proven during space flight. This scale allows NASA to better understand the risks in a project and make the appropriate decisions.

Technological risk is just one factor affecting the requirements for peer reviews of DOE projects. Potential environmental safety and health risks often drive the need for independent reviews. The organizational complexity of DOE projects, which involve multiple labs and funding organizations, often with different management cultures, and the varying levels of experience of the IPTs and federal project directors also present risks that must be reviewed to ensure that a project can be successfully executed.

Setting EIR requirements based on threshold criteria for risk factors and project team capabilities is beyond the scope of this study. However, such criteria could be developed to assess risk using tools similar to the NASA technology readiness scale or to assess the project management team's capabilities based on DOE's project manager career development program (PMCDP) (DOE, 2004). And criteria to assess risks associated with project planning could be based on tools like the Construction Industry Institute's Project Definition Rating Index (CII, 2006). Such criteria and tools should be reliable but they do not need to be precise. They could be used to categorize projects as high risk or low risk and, when combined with the TPC, would provide some direction for tailoring and developing a peer review plan.

Table 3.2 summarizes the committee's guidelines for determining the appropriate type of review, the timing of reviews, and the responsible office. Projects have been categorized as small, intermediate, large, and major systems, based on TPC thresholds in O 413.3A (DOE, 2006).

Under each category and each critical decision on Table 3.2, the committee has first identified the type of review to be conducted by default. Thus, for large projects prior to CD-0, an IPR is the default, whereas an EIR is the default for small projects prior to CD-2. It is important to note that the committee's recommendation for the review to be conducted by default does not necessarily parallel Order 413.3A.

The committee has also identified the types of reviews that should be used if the project is determined to be either high or low risk. Thus, an EIR would be required for a large project at CD-2 unless the project was determined to be low risk, in which case an IPR would be appropriate.

The level of risk should be determined based on a number of factors, including TPC, complexity, technological readiness, the capabilities of the project management team, or other factors. For example, if a project is costly, complex, inherently risky, or if the project management team's capabilities are poor, the project could be considered high risk. In contrast, if a project is routine in nature, with few risks, and/or the project management team is very capable, the project might be considered low risk. Additional explanatory text follows.

Reviews Prior to Approval of Mission Need (CD-0)

For small, routine projects, no peer reviews should be required unless the project is determined to be high risk, in which case an IPR is recommended. For intermediate projects, an IPR should be required. For large projects and major systems, an IPR should be required unless the project is determined to be high risk, in which case some form of EIR may be warranted. The determination that a project is high risk should be made by the PSO, and all reviews conducted by the PSO.

Reviews Prior to Approval of Alternative Selection and Cost Range (CD-1)

An IPR should be required for all projects. For large projects and major systems determined to be high risk, an EIR may be warranted. This determination should be made by the PSO and all reviews conducted by the PSO.

Reviews Prior to Approval of Baseline Performance (CD-2)

For small and intermediate projects, an EIR should be required unless the project is evaluated by the PSO and determined to be low risk, in which case an IPR is warranted. This determination should be made by the PSO with the OECM's concurrence; the IPR or EIR should be conducted by the PSO.

TABLE 3.2 Recommended Guidelines for Peer Review Planning.

Project Size/TPC	Project Phase				
	Prior to CD-0	Prior to CD-1	Prior to CD-2	Prior to CD-3	Prior to CD-4
Small - TPC $5 Million to $20 Million	Nothing — Unless ** then IPR	IPR—	EIR — Unless * then IPR	IPR—	Nothing— Unless ** then IPR
Intermediate - TPC $20 million to $100 million	IPR—	IPR—	ÉIR— Unless * then IPR	IPR— Unless ** then EIR	Nothing — Unless ** then IPR
Large - TPC $100 million to $750 million	IPR— Unless ** then EIR	IPR— Unless ** then EIR	IPR and EIR— sequential or simultaneous **	IPR— Unless ** then EIR	IPR— Annual until CD-4
Major System TPC Greater than $750 million	IPR— Unless ** then EIR	IPR— Unless ** then EIR	IPR and EIR— sequential or simultaneous ** Annual IPR until CD-3—	IPR and EIR— sequential or simultaneous **	IPR— Annual until CD-4

—	Default - review required
*	Review to be used by default **unless** project complexity, inherent risks, project management team capabilities or other factors warrant a different type of review
**	Review to be used by default **unless** project complexity, inherent risks, project management team capabilities or other factors warrant a different type of review

Determination by OECM

Determination by PSO

For large projects and major systems, both an IPR and an EIR should be required. These reviews should be coordinated so that either the IPR occurs first to validate the technical scope of work prior to the EIR or, if warranted by the characteristics of the project, the reviews occur simultaneously. The IPR should be conducted by the PSO, and the EIR should be conducted by the OECM, unless the OECM determines the project is low risk, in which case both reviews should be conducted by the PSO.

For major systems, if more than 1 year elapses between CD-2 and CD-3, an annual IPR should be required and be conducted by the PSO.

Reviews Prior to Start of Construction (CD-3)

For small projects, an IPR should be required and conducted by the PSO. For intermediate and large projects, an IPR should be required unless the project is determined to be high risk, in which case an EIR may be warranted. This determination should be made by the PSO with the OECM's concurrence. The IPR should be conducted by the PSO, and the EIR should be conducted by the OECM.

For major systems, both an IPR and an EIR should be required. The two reviews should be coordinated such that either the IPR occurs first to validate that the project is ready for construction prior to the EIR or they occur simultaneously. The IPR should be conducted by the PSO and the EIR by the OECM.

Reviews Prior to Approval of Start of Operations or Project Closeout (CD-4)

No reviews should be required for small and intermediate projects unless the PSO determines the project is high risk, in which case an IPR may be warranted. For large projects and major systems, an IPR should be required. If the time elapsing between CD-3 and CD-4 is more than 1 year, an annual IPR should also be required and should be conducted by the PSO.

The committee believes that all peer reviews conducted during the course of a project are important. However, the committee supports an emphasis on reviews prior to CD-2 because it is during front-end planning when the ability to influence the outcome of a project is greatest.

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4
Conclusions, Findings, and Recommendations

CONCLUSIONS

The committee's charge calls for advice on how EIRs can be tailored to a mix of project types to ensure that essential information is provided at the optimum point in the CD process and that resources are used effectively. DOE policies designate EIRs as the primary process for validating project performance baselines before submitting a request for project funding to Congress.

If EIRs are intended only to validate project performance baselines, then the current review planning procedures, the practice of employing outside contractors responding directly to the OECM, and the use of a standardized set of key review elements might be appropriate. However, DOE project directors and program managers reported additional benefits from both EIRs and IPRs including professional development, management process improvement, transfer of lessons learned from other sites and projects, and improved communication between DOE staff and contractor personnel. Further, the benefits of peer reviews often accrue in the form of avoidance of future problems and increased confidence in project performance, benefits which are difficult to quantify. The value and cost-effectiveness of EIRs would be enhanced if they were planned more carefully with the broader involvement of all stakeholders, tailored in a more flexible manner using a collaborative process, and integrated into the complete portfolio of reviews that are used to monitor and support DOE projects. In addition, EIR reports can be a source of valuable lessons learned which could be used to help improve project management within the DOE. The committee's findings and recommendations below address this view of the enhanced role of EIRs.

FINDINGS

Finding 1: DOE employs a variety of peer reviews to assess risk and other factors that bear on design, safety, cost estimates, value engineering, and project management. Because the responsibility for organizing the reviews is dispersed throughout the department, the planning of project reviews is not well coordinated.

EIRs and IPRs are the predominant types of peer reviews initiated by the OECM and the PSOs. Current DOE practices disperse the responsibility for organizing the various types of reviews: contractors manage independent design and technical reviews, the PSOs manage IPRs, and the OECM manages EIRs. The result is an uncoordinated use of peer reviews throughout the department.

Currently, EIR review teams focus on validation of the cost and schedule baseline. The scope of work or the specific technical approaches and risks are assessed by IPRs. Because the cost and schedule baseline can be valid only if the scope is valid and stable, it is essential that the planning of IPRs and EIRs be coordinated to ensure that the risk associated with future scope changes are addressed in the baseline budget.

Finding 2: The value of a peer review (IPR or EIR) depends, in large part, on the experience and expertise of the review team, its capacity to understand the requirements of the project, its independence, and its ability to make objective assessments and recommendations. Assembling teams that have both expertise and independence can be difficult, especially for the complex, one-of-a-kind projects sometimes undertaken by DOE.

DOE projects often involve specialized scientific equipment or innovative technologies with significant risks and implementation challenges. The nonroutine, sometimes unique, nature of DOE projects requires a case-by-case treatment. For this reason, EIRs often require peer reviewers who have unique expertise. In addition, critical issues change over the course of a project's development, with planning issues dominating in early stages and implementation issues becoming more important at later stages. As a result, the composition of an appropriate review team must be carefully considered to ensure that members have the appropriate expertise.

Currently, IPRs primarily rely on reviewers from within the DOE community, who may lack full objectivity, while EIRs rely on reviewers from outside the DOE community, who may sometimes not have the requisite expertise. In the long term, reviews can be conducted by teams using both internal and external reviewers as needed to address the critical issues presented by the project. For projects with specialized requirements, a team composed of external and internal reviewers could provide a balance between independence and the technical focus needed to effectively assess the inherent risks in proposed project scopes of work, budgets, and schedules, and to serve a broader audience. Validation of a project scope may require more internal reviewers, while validation of cost and schedule may require more external reviewers.

Finding 3: Total project cost is the leading criterion in guiding the planning and scheduling of reviews. Additional criteria may be equally appropriate**.**

Decisions for planning appropriate peer reviews need to be based in part on TPC, but should also consider other critical project success factors such as inherent risks, complexity, technology readiness, the capabilities of the project management team, and the amount of time elapsing between CD milestones.

Finding 4: Peer reviews (IPRs or EIRs) conducted prior to approval of mission need (CD-0) and again prior to approval of the alternative selection and cost range (CD-1) could play a valuable role in risk management and quality assurance during front-end project planning. Some projects could probably benefit from annual reviews for quality assurance purposes when the time between critical decision milestones exceeds 1 year.

The Construction Industry Institute's (CII's) benchmarking program has shown that the quality and completeness of a project's front-end planning are linked to the probability of success of a project and that an owner's best opportunities to influence the outcome of a project occur at the front-end (CII, 1996). The greater the complexity and risks of a project, the greater the need to ensure the validity of early critical decisions.

Risks in large and complex projects change as the project develops. The potential for change justifies the need for some form of periodic peer review. Such reviews could provide a fresh look at the project, account for changing circumstances, identify emerging problems, and revisit project assumptions and the information upon which decisions were made to ensure they remain valid.

Finding 5: Problems in communication stemming from the prereview planning process have occurred when an EIR team arrived at a significant finding after the on-site exit briefing but did not relay the finding to DOE staff until delivery of the final report.

The committee observed that the development of a report guide by the OECM improved the overall organization and consistency of the reports. Some concern was expressed by DOE personnel that the reports took too long to produce after completion of the on-site review sessions, but this time, generally about one week to complete the first draft, did not seem to the committee to be excessive. Problems in communication stemming from the pre-review planning process seemed to be present in instances where the EIR team developed additional significant findings after the on-site exit interview but did not communicate those findings until delivery of the final report, which may occur several months after the exit briefing. Such a delay in communication on major findings hinders the ability of the IPT to begin corrective actions expeditiously.

Finding 6: The purpose of tailoring is to refine the focus of the EIR to suit the particular characteristics of a project. DOE policies emphasize the need for tailoring, but the committee observed little evidence of effective tailoring.

DOE O 413.3 recognizes the essential need to tailor EIRs to specific project requirements. The Order gives responsibility for tailoring to the project team but places the OECM in control of the EIR.

Determining how to tailor an EIR requires experience as well as judgment about the value of peer reviews per se. For example, tailoring that involved eliminating the on-site sessions for smaller projects was reported to severely diminish the effectiveness of the EIR. Because much of the value of a peer review lies in the interaction of the participants, it is not surprising that eliminating the on-site review was counterproductive. In contrast, tailoring that was done by a collaboration of the EIR contractor, the IPT, the PSO, and the OECM produced effective reviews.

Finding 7: A clearly defined, systematic process for capturing data from peer reviews along with a system to catalogue, store, and disseminate this information is needed and, if implemented, would greatly enhance the benefits derived from peer reviews.

Peer reviews (EIRS and IPRs) can be a primary vehicle for gauging an organization's project management and maturing it. When EIR contractors are exposed to problems and solutions from multiple projects at multiple sites they can disseminate lessons learned through on-site discussions and EIR reports. DOE staff and M&O contractors who participate in IPRs are exposed to methods and procedures from other sites and bring their experience to benefit the personnel associated with the project being reviewed. For small projects undertaken by less experienced personnel, EIRs were reported to provide training and contribute to their professional development. However, lessons learned from EIRs and IPRs have not been documented systematically.

Finding 8: EIRs and other peer reviews are an intrinsic part of project management and are an integral part of project costs. The current policy of funding EIRs from program direction funds places them in competition with other program activities.

The current practice of funding EIR contract costs (travel and consultant personnel) from the program direction budgets puts pressure on DOE program managers to choose between funding EIRs and funding personnel training and other activities to improve project management. IPRs are favored by the PSOs because the majority of costs, except for travel, are absorbed by existing personnel budgets. Because IPRs require direct funding only for the travel expenses of the review team, there is a bias in favor of IPRs and a bias against the value of EIRs.

The mechanism for funding EIRs and other reviews affects more than the availability of funds to conduct reviews. It is counterproductive to place these reviews in a zero-sum game with program direction funds for overall department management. This competition leads to a less than enthusiastic approach to EIRs on the part of the PSOs and the project teams. The selection of the type of review

should be based on which one provides the most benefit to the project and the department rather than the funding source.

RECOMMENDATIONS

Recommendation 1: EIRs should be integrated into a comprehensive peer review process. To accomplish this,

- A comprehensive plan to coordinate the planning for all project peer reviews should be developed by the integrated project team (IPT), with input from the OECM and the PSOs. Plans for peer reviews should be included in the project execution plan and the quality assurance program.
- The IPT, the PSOs, and the OECM should determine the types of and schedules for these reviews using the guidelines shown in Table S-1. It is important to note that the committee's recommendations for reviews to be conducted by default do not necessarily parallel Order 413.3A.
- In addition to the TPC, the criteria for determining the appropriate type, form, and timing of a review should include project complexity; severity and types of inherent risks; project management maturity; and the qualifications and experience of the project teams. These criteria should be developed jointly by the OECM and the PSOs.
- EIRs should be planned and executed jointly by the OECM, the PSOs, and the IPTs. The office responsible for validating the performance baseline (CD-2) should take the lead for reviews that occur prior to CD-2.
- For projects with TPCs less than $100 million, an EIR should be required to validate the performance baseline (CD-2) unless project complexity, inherent risks, project management capabilities, or other factors warrant conducting an IPR. The determination of the most appropriate type of review should be made by the PSO.
- For some projects, a review (IPR or EIR) should be conducted prior to CD-0 and then again prior to CD-1 if warranted by the project complexity, inherent risks, project management capabilities, or other factors. After CD-2, when the elapsed time between critical decision milestones exceeds 1 year, an annual IPR should be conducted for quality assurance purposes.

Recommendation 2: EIRs should assess whether the particular project management team— i.e., project manager, project team, federal project director, and IPT—has the ability to execute the project successfully. This assessment should evaluate the qualifications and experience of the project management team, the project's organizational structure, and the communication and decision-making processes in place.

Recommendation 3: EIR review teams should be selected to provide the experience and expertise necessary to evaluate a project's baseline cost, schedule, scope, inherent risks, and the capabilities of the project management team. The acquisition executive could add DOE contractor personnel who are not project advocates to EIR teams when outside technical expertise is not available. In the long term, the distinction between the EIR and IPR review teams can be lessened and review team members from within DOE and external to it can be selected as needed to address the critical issues presented by each project.

Recommendation 4: The OECM, the PSOs, and the IPT should collaborate on the tailoring of reviews**.** They should determine which key review elements should be emphasized and which ones should be streamlined based on their assessment of project risks, complexity, and cost.

TABLE S.1 Recommended Guidelines for Planning Peer Reviews.

Project Size/TPC	Project Phase				
	Prior to CD-0	Prior to CD-1	Prior to CD-2	Prior to CD-3	Prior to CD-4
Small, TPC $5 million to $20 million	Nothing— unless **, then IPR	IPR—	EIR— unless *, then IPR	IPR—	Nothing— unless **, then IPR
Intermediate, TPC $20 million to $100 million	IPR—	IPR—	ÉIR— unless *, then IPR	IPR— unless **, then EIR	Nothing— unless **, then IPR
Large, - TPC $100 million to $750 million	IPR— unless **, then EIR	IPR— unless **, then EIR	IPR and EIR— sequential or simultaneous **	IPR— unless *,* then EIR	IPR— annual until CD-4
Major system, TPC >$750 million	IPR— unless **, then EIR	IPR— unless **, then EIR	IPR and EIR— sequential or simultaneous ** Annual IPR until CD-3—	IPR and EIR— sequential or simultaneous **	IPR— annual until CD-4

—	Default - review required	
*	Review **to be used by** default **unless** project complexity, inherent risks, project management team capabilities or other factors warrant conducting a different type of review	Determination by OECM
**	Review **to be used by** default **unless** project complexity, inherent risks, project management team capabilities or other factors warrant conducting a different type of review	Determination by PSO

Recommendation 5: Communication among all EIR participants should be improved from initial planning of the reviews through taking corrective actions:

- If significant findings are arrived at subsequent to the formal on-site exit briefing, the EIR team should notify the IPT immediately and not wait until delivery of the final report.
- Postreview assessments of the quality of the review process for EIRs should be conducted and led by the OECM with input from the IPT and the PSO. The purpose is to improve future reviews and provide input to the annual contractor performance appraisal.

Recommendation 6: The DOE should document lessons learned from peer reviews and disseminate them throughout the department.

- The OECM should establish a process to document and disseminate the lessons learned from all peer reviews across all program offices. The process should be developed through a coordinated effort with the full participation of the PSOs.
- EIRs should clearly identify best practices observed in order to facilitate the lessons learned process.

Recommendation 7: DOE should view peer reviews as an intrinsic component of project management.

- The costs for EIRs and IPRs should be covered by project funding—that is, be part of the preliminary engineering design funds prior to CD-2 and a part of project funds when these funds have become available to the PSO.
- Prereview planning decisions about the most appropriate type of review (EIR or IPR) should be based on full-cost accounting of either type of review.

Appendixes

A
Biographies of Committee Members and Consultant

COMMITTEE MEMBERS

Joseph P. Colaco *(Chair*) is president of CBM Engineering Inc., a structural engineering consulting firm. Since 1975, he has served as the principal in charge of many tall buildings and other major construction projects including the Texas Commerce Tower, Houston, Texas; Two Prudential Plaza, Chicago, Illinois; Lake Robbins Bridge, The Woodlands, Texas; and the Guoman Hotel/Office building, Kuala Lumpur, Malaysia, among others. He is a visiting lecturer at the University of Houston School of Architecture and has also lectured at Rice University. He is a member of the National Academy of Engineering, the American Society of Civil Engineers, and the National Society of Professional Engineers and is a fellow in the Institute of Structural Engineers and the American Concrete Institute. Dr. Colaco holds an M.S. and a Ph.D. in civil engineering from the University of Illinois.

Don Jeffery (Jeff) Bostock (*Vice Chair*) retired from Lockheed Martin Energy Systems Inc., as vice president for engineering and construction with responsibility for all engineering activities within the Oak Ridge nuclear complex. He has extensive experience managing projects as a DOE contractor. He has also served as vice president of defense and manufacturing and manager of the Oak Ridge Y-12 plant, a nuclear weapons fabrication and manufacturing facility. His career at Oak Ridge included engineering and managerial positions in all of the various manufacturing, assembly, security, and program management organizations. He also served as manager of the Paducah Gaseous Diffusion Plant. He was a member of the committees that produced the NRC reports *Proliferation Concerns: Assessing U.S. Efforts to Help Contain Nuclear and Other Dangerous Materials* and *Technologies in the Former Soviet Union, and Protecting Nuclear Weapons Material in Russia*. Mr. Bostock has also served as a panel member for the annual NRC assessment of the National Institute of Standards and Technology Measurement and Standards Laboratories. He was also a member of the NRC Committee on Oversight and Assessment of Department of Energy Project Management between 2000 and 2005. Mr. Bostock has a B.S. in industrial engineering from Pennsylvania State University and an M.S. in industrial management from the University of Tennessee. He is a graduate of the Pittsburgh Management Program for Executives.

David B. Ashley is president of the University of Nevada, Las Vegas. Prior to taking this post in July 2006, he was the executive vice chancellor and provost and held the Shaffer-George Chair in Engineering at the University of California, Merced. Prior to joining UC Merced in July 2001, he was the dean of engineering at the Ohio State University. He has also been on the civil and environmental engineering faculties of UC Berkeley, the University of Texas, and the Massachusetts Institute of Technology. His principal research and teaching activities are in the area of construction project planning, focusing especially on risk analysis and management of large-scale, complex projects. His work within this field has brought him recognition as a National Science Foundation Presidential Young Investigator, the Construction Management Award from the American Society of Civil Engineers, and an honorary doctorate from Chalmers University in Sweden. Dr. Ashley holds a B.S. and an M.S. in civil engineering from the Massachusetts Institute of Technology and an M.S. in engineering economic systems and a Ph.D. in construction engineering management from Stanford University.

Allan V. Burman is president of Jefferson Solutions, a division of the Jefferson Consulting Group, a firm that provides change management services and acquisition reform training to many federal departments and agencies. He is an expert in federal acquisition, procurement, and budget reform. Dr. Burman provides strategic consulting services to private sector firms doing business with the federal government as well as to federal agencies and other government entities. He has also advised firms, congressional committees, and federal and state agencies on a variety of management and acquisition reform matters. Prior to joining the Jefferson Consulting Group, Dr. Burman had a lengthy career in the federal government, including administrator for federal procurement policy in the Office of Management and Budget (OMB), where he testified before Congress more than 40 times on management, acquisition, and budget matters. Dr. Burman also authored the 1991 policy letter that established performance-based contracting and greater reliance, where appropriate, on fixed-price contracting, as the favored approach for contract reform. As a member of the Senior Executive Service, Dr. Burman served as chief of the Air Force Branch in OMB's National Security Division, and he was the first OMB branch chief to receive a Presidential Rank Award. Dr. Burman is a fellow and member of the board of advisors of the National Contract Management Association, a principal of the Council for Excellence in Government, a director of the Procurement Round Table, and an honorary member of the National Defense Industrial Association. He is also a contributing editor and writer for *Government Executive* magazine. Dr. Burman obtained a B.A. from Wesleyan University; was a Fulbright Scholar at the Institute of Political Studies, University of Bordeaux, France; and has a graduate degree from Harvard University and a Ph.D. from the George Washington University.

Robin Dillon-Merrill is an assistant professor at the McDonough School of Business at Georgetown University. She specializes in risk and decision analysis. The focus of her research is using programmatic risk analysis to improve project and operational management in complex, resource-constrained environments, which are typical of DOE projects. Dr. Dillon-Merrill's work has been applied in the selection of a new tritium supply facility for DOE and in the assessment of options for unmanned space missions for the Jet Propulsion Laboratory. She has coauthored papers with the nation's leading risk and decision analysts. Dr. Dillon-Merrill received her Ph.D. in engineering risk analysis from Stanford University and her M.S. and B.S. degrees (with highest distinction) from the University of Virginia.

G. Brian Estes is the former director of construction projects, Westinghouse Hanford Company, where he directed project management functions for construction projects in support of operations and environmental cleanup of DOE's Hanford nuclear complex. Prior to joining Westinghouse, he completed 30 years in the Navy Civil Engineer Corps, achieving the rank of rear admiral. Admiral Estes served as commander of the Pacific Division of the Naval Facilities Engineering Command and as commander of the Third Naval Construction Brigade, Pearl Harbor, Hawaii. He supervised more than 700 engineers, 8,000 Seabees, and 4,000 other employees in providing public works management, environmental support, family housing support, facility planning, and design and construction services. As vice commander, Naval Facilities Engineering Command, Admiral Estes led the total quality management transformation at headquarters and two updates of the corporate strategic plan. Admiral Estes directed execution of a $2 billion military construction program and a $3 billion facilities management program while serving as deputy commander for facilities acquisition and deputy commander for public works, Naval Facilities Engineering Command. He served on the committee that produced the recent NRC report Improving Project Management in the Department of Energy, and has served on a number of other NRC committees. He holds a B.S. in civil engineering from the University of Maine and an M.S. in civil engineering from the University of Illinois, and he is a registered professional engineer in Illinois and Virginia.

William A. Fife is corporate vice president and leader of DMJM Harris's aviation practice. He has 30 years of experience in the management of large construction projects, gained primarily in the Aviation

Project Management and Technical Service Division of the Port Authority of New York and New Jersey. As general manager of that division, Mr. Fife was responsible for all project management, planning, technical, and support services related to the Aviation Department's capital and operating programs. He is a member of the American Society of Civil Engineers–Air Transport Division, a U.S. representative for the Airports Council International, and a member of the American Association of Airport Executives. Mr. Fife is a co-chair of the Airport Peer Review Group for airports in the United States and Canada, including Boston, Washington, D.C. (Reagan National, Dulles), Miami, Toronto, Montreal, Las Vegas, and others. He has been a guest lecturer at the Massachusetts Institute of Technology, the University of California, Berkeley, Manhattan College, Columbia University and other colleges and universities. Mr. Fife holds a bachelor's degree in electrical engineering from Manhattan College, an M.S. in industrial engineering from the Polytechnic Institute of New York, and an M.P.A. from Long Island University.

Chris T. Hendrickson is the Duquesne Light Company Professor of Engineering at Carnegie Mellon University. His research, teaching, and consulting are in the general area of engineering planning and management, including design for the environment, system performance, project management, finance, and computer applications. He has coauthored two textbooks, *Project Management for Construction* and *Transportation Investment and Pricing Principles* and two monographs, "Knowledge Based Process Planning for Construction and Manufacturing" and "Concurrent Computer Integrated Building Design." Dr. Hendrickson is editor of the *Journal of Transportation Engineering.* He has been a recipient of the Fenves Systems Research Award (2002), AT&T Industrial Ecology Fellowships (2000-2002), a Lucent/NSF Industrial Ecology Fellowship (1998), the ASCE Frank M. Masters Transportation Engineering Award (1994), the Outstanding Professor of the Year Award of the ASCE Pittsburgh Section (1990), the ASCE Walter L. Huber Civil Engineering Research Award (1989), the Benjamin Richard Teare Teaching Award from the Carnegie Institute of Technology (1987), and a Rhodes scholarship (1973). Dr. Hendrickson holds a B.S. and an M.S. from Stanford University, an M.Phil. in economics from Oxford University, and a Ph.D. from the Massachusetts Institute of Technology.

Linda K. Nozick is a professor in the School of Civil and Environmental Engineering at Cornell University, where she also serves as a director of graduate studies for systems engineering. Prior to her teaching at Cornell, she was a visiting professor in operations research at both the Naval Postgraduate School and General Motors Global Research and Development. She is a recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE) and the CAREER Award from NSF. She has published extensively on issues in transportation, optimization, and decision making under uncertainty. Dr. Nozick was a member of the NRC Committee on Renewal of Department of Energy Infrastructure. She is a member of numerous professional organizations dealing with operations research and transportation research. Dr. Nozick has a B.S. in systems analysis and engineering from George Washington University and an M.S. and a Ph.D. in systems engineering from the University of Pennsylvania.

Gary H. Sanders is project manager for the Thirty Meter Telescope (TMT) at the California Institute of Technology. Prior to assuming management of the TMT, he managed construction of the Laser-Interferometer Gravitational-Wave Observatory at Caltech. He served as an experimental high-energy physicist and program manager at Los Alamos National Laboratory and has been involved in high-energy physics at other national and European laboratories. Dr. Sanders is a fellow of the American Physical Society. He holds a B.A. from Columbia University and a Ph.D. from the Massachusetts Institute of Technology.

Scott B. Smith is the executive director of the Institute for Security Studies at the University of Nevada, Las Vegas. Prior to taking up this post in October 2006, he was the chief executive officer for Western Research Institute, a scientific and technical organization specializing in energy, environmental, and highway materials research for clients in government, business, and industry. He had been at WRI since

February 1999. He served in the U.S. Army, retiring in 1989 as a major general and having completed tours of duty as a deputy assistant secretary of defense, commanding general of the Europe Engineer Division (Frankfurt, Germany), commanding general of the North Central Engineer Division (Chicago), assistant commanding general of the 7th Infantry Division (Fort Ord, California), commander of the Huntington Engineer District (West Virginia), and commander of an engineer battalion in the 1st Cavalry Division in Vietnam. Immediately upon his retirement from the Army, General Smith directed the environmental, health, and safety program for the Coors Brewing Company. He holds a B.S. from the U.S. Military Academy, an M.S. in civil engineering from the University of Illinois, and an M.P.A. from Pennsylvania State University

CONSULTANT

Lloyd A. Duscha retired from the U.S. Army Corps of Engineers in 1990 as the highest-ranking civilian, serving as deputy director, Engineering and Construction Directorate, at headquarters. Prior to that, he served in numerous Corps of Engineers executive management positions involving design and construction of civil works and military projects. After retirement, Mr. Duscha was an engineering and management consultant to various private sector clients, national and foreign government agencies, and the World Bank. He was principal investigator for the NRC report *Assessing the Need for Independent Project Review in the Department of Energy*, was a member of the committee that produced the NRC report *Improving Project Management in the Department of Energy*, and served on the succeeding committees on oversight and assessment of DOE project management. He has served on numerous other NRC committees for the Board on Infrastructure and the Constructed Environment, as well as for the Naval Studies Board and the Nuclear and Radiation Studies Board. Currently, he serves on a National Academy of Public Administration panel reviewing the organization and management of the Environmental Management Program at DOE. He also served on the Board on Infrastructure and the Constructed Environment and was vice chair for the U.S. National Committee on Tunneling Technology. Other positions held were president, U.S. Committee on Large Dams; chair, Committee on Dam Safety, International Commission on Large Dams; executive committee, Construction Industry Institute; and the board of directors, Research and Management Foundation of the American Consulting Engineers Council. He is a fellow of the American Society of Civil Engineers and the Society of American Military Engineers. He holds a B.S. in civil engineering from the University of Minnesota, which awarded him the Board of Regents Outstanding Achievement Award. Mr. Duscha is a member of the National Academy of Engineering.

B
EIR Documents Reviewed by the Committee

The committee, with input from the Office of Engineering and Construction Management, identified a representative sample of DOE projects and EIR documents. The sample includes projects from the three DOE program offices that are responsible for the majority of construction projects and a representative distribution of project size, complexity, and performance. The sample includes reports from all three EIR contractors employed by DOE prior to 2006. OECM and the project management support offices provided the committee all available data for each project. Variations in the data from project to project are due to changes in policies and procedures over time, the approach of individual contractors and PSOs, and the characteristics of the project. The committee conducted teleconferences with federal project directors of selected projects, who are listed below.

NATIONAL NUCLEAR SECURITY ADMINISTRATION

Building 431 Demolition Project (OPEX-1)
$12 million, Status: Green
Lawrence Livermore National Laboratory
Federal Project Director: Tony Sy
Data:
Jupiter Corporation. December 7, 2004. Executive Summary, the External Independent Review of Building 431 Demolition Project; Approve Performance Baseline/ Start Field Work (CD-2/3).
Jupiter Corporation. January 3, 2005. Final Report External Independent Review of the Building 431 Demolition; Approve Performance Baseline / Start Field Work (CD-2/3).

Electrical Distribution System Upgrade (EDSU) (06-D-160-3)
$13.1 million, Status: Green
Pantex
Federal Project Director: Johnnie Guelker, CPD(3)
Data:
Jupiter Corporation. December 7, 2005. External Independent Review of Electrical Distribution System Upgrade Project; Approve Performance Baseline (CD-2).

Terascale Simulation Facility CPD(3)
$95.3 million, Status: Green
Lawrence Livermore National Laboratory
Data:
Logistics Management Institute (LMI). July 1999. External Independent Review of the Terascale Simulation Facility.
LMI. August 2001. Independent Cost Review, EIR [Corrective Action Plan] Cap Review, Execution Readiness EIR of the Terascale Simulation Facility.

Replace Fire Stations No. 1 and No. 2
$25.4 million, Status: Start Up
Nevada Test Site
Federal Project Director: Bob Platoni
Data:
Jupiter Corporation. December 21, 2005. Independent Cost Estimate Addendum to the External Independent Review Dated December 6, 2006.
Jupiter Corporation. December 6, 2005. External Independent Review of the Replace Fire Stations No. 1 and No 2, Approve Performance Baseline (CD-2).

Z-Accelerator Refurbishment Project
$90.4 million, Status: Green
Sandia National Laboratory
Federal Project Director: Frank White
Data:
Jupiter Corporation. September 16, 2004. Final Report of the External Independent Review of Z Accelerator Refurbishment Project (ZR), Approve Performance Baseline /Approve Long-Lead Equipment Procurement (CD-2/3A).
Department of Energy. September 10, 2004. Corrective Action Plan, Draft EIR Report Appendix E.

Building 64 Production Bay Upgrade (05-D-401)
$44.1 million, Status: Red
Pantex
Data:
Jupiter Corporation. July 28, 2004. Building 64 Production Bay Upgrade Project No. 05-D-401, Approve Performance Baseline (CD-2).

Microsystems and Engineering Sciences Applications (MESA) Project Title II
$517.3 million, Status: Green
Sandia National Laboratory
Federal Project Director: Jeanette Norte
Data:
Logistics Management Institute. November 2001. Independent Cost Review, External Independent Review, EIR Corrective Action Plan Review of the Microsystems and Engineering Sciences Applications (MESA).
Burns and Roe Enterprises, Inc. February 2003. Large Scale Projects External Independent Review of the Microsystems and Engineering Sciences Applications (MESA) Project Title II.

Highly Enriched Uranium Materials Facility (HEUF), Building 9720-82 (01-D-124)
$334.6 million, Status: Red
Oak Ridge National Laboratory Y-12
Federal Project Director: Scott Cannon
Data:
Jupiter Corporation. June 16, 2000. Independent Review and Assessment of the Highly Enriched Uranium Materials Facility.
Logistics Management Institute (LMI). June 2003. External Independent Review, Performance Baseline Review of the Highly Enriched Uranium Materials Facility.
LMI. August 2004. Limited External Independent Review, Baseline Change Proposal Review of the Highly Enriched Uranium Materials Facility Project.
Department of Energy. August 2004. Corrective Action Plan, Limited External Independent Review of the Highly Enriched Uranium Materials Facility Project Appendix C.

OFFICE OF SCIENCE

Fundamental Neutron Physics Beamline (FNPB)
$ 9.3 million, Status: Green
Oak Ridge National Laboratory
Federal Project Director: David Arakawa
Data:
Department of Energy (DOE). June 18, 2004. Corrective Action Plan.
Jupiter Corporation. June 22, 2004. Draft External Independent Review of Fundamental External Independent Review.
Jupiter Corporation. July 08, 2004. Fundamental Neutron Physics Beamline Project Approve Performance Baseline (CD-2), Comment Resolution Document.
Jupiter Corporation. July 08, 2004. External Independent Review Fundamental Neutron Physics Beamline Project Approve Performance Baseline CD-2, Final Report.
DOE. August 26, 2004. Memorandum from James Rispoli, Director, Office of Engineering and Construction Management to Raymond Orbach, Director, Office of Science. Transmittal of the EIR.
DOE. February 7-8, 2005. Annual Technical Progress Review of the Fundamental Neutron Physics Beam-Line Project.
DOE. February 9-10, 2006. Annual Technical Progress Review of the Fundamental Neutron Physics Beam-Line Project.

Research Support Building-Phase I (MEL-001-027)
$18.3 million, Status: Green
Brookhaven National Laboratory
Federal Project Director: Joseph Eng
Data:
Department of Energy (DOE). November 2003. Response to Draft EIR Dated November 21, 2003, Factual Accuracy.
Jupiter Corporation. December 18, 2003. External Independent Review of Research Support Building—Phase I Project.
Jupiter Corporation. December 18, 2003. External Independent Review of Research Support Building—Phase I Project, Comment Resolution Document.
DOE. January 8, 2004. Memorandum from James Rispoli, Director, Office of Engineering and Construction Management to Raymond Orbach, Director, Office of Science. Transmittal of the EIR.
DOE. April 14, 2004. EIR Team Response to Corrective Action Plan.
DOE. April 20, 2004. Memorandum from James Rispoli, Director, Office of Engineering and Construction Management to Raymond Orbach, Director, Office of Science. Validation of Baseline.

Center for Nanophase Materials Sciences (CNMS) (03-R-312)
$ 65 million, Status: Green
Oak Ridge National Laboratory
Federal Project Director: David Arakawa
Data:
Jupiter Corporation. August 20, 2002. External Independent Review of Center for Nanophase Materials Sciences, Final Report.
Department of Energy (DOE). August 29, 2002, revised October 12, 2002, revised January 30, 2003. Corrective Action Plan.

The Molecular Foundry (TMF) (04-R-313)
$85 million, Status: Green
Lawrence Berkeley National Laboratory
Federal Project Director: Katherine Johnescu
Data:
Jupiter Corporation. July 17, 2003. External Independent Review of the Molecular Foundry (TMF).
Jupiter Corporation. July 17, 2003. External Independent Review of the Molecular Foundry (TMF), Comment Resolution.

Linac Coherent Light Source (LCLS) (03-SC-002/05-R-320)
$379 million, Status: Green
Stanford Linear Accelerator Center
Federal Project Director: Hanley Lee
Data:
Burns and Roe. June 2004. External Independent Review of the Linac Coherent Light Source Project Baseline, and response to factual comments.
Burns and Roe. January 2005. Limited External Independent Review of the Revised Linac Coherent Light Source Project Baseline.
Burns and Roe. March 2005. Limited External Independent Review of the Revised Linac Coherent Light Source Project Baseline.
Burns and Roe. April 2005. Limited External Independent Review of the Revised Linac Coherent Light Source Project Baseline.
Department of Energy (DOE). February 02, 2005. Memorandum from James Rispoli, Director, Office of Engineering and Construction Management to Raymond Orbach, Director, Office of Science. Non-Validation of Baseline.
DOE. June 07, 2005. Memorandum from James Rispoli, Director, Office of Engineering and Construction Management to Raymond Orbach, Director, Office of Science. Validation of Baseline.

OFFICE OF ENVIRONMENTAL MANAGEMENT

Glass Waste Storage Building #2, (2035:04-D-408)
$77.4 million, Status: Green
Savannah River Site
Federal Project Director: Guy Girard
Data:
Jupiter Corporation. March 29, 2004, revised April 27, 2004. External Independent Review of Glass Waste Storage Building #2, Approve Performance Baseline /Approve Start of Construction Review CD-2/3.

Depleted Uranium Hexafluoride 6 (DUF6) Conversion, (UE D&D:02-U-101)
$345.5 million, Status: Green
Portsmouth & Paducah
Federal Project Director: Jack Zimmerman
Data:
Logistics Management Institute (LMI). November, 2003. DUF6 Project Reconfiguration Limited Review
LMI. June 2004. Duf_6 Conversion Plan Project, Limited External Independent Review.
LMI. September 2004. Acquisition Performance Baseline EIR (for CD-2) of The Depleted Uranium Hexafluoride Conversion Project.

Department of Energy (DOE). April 6, 2005. Memorandum from Robert McMullen, ESAB Secretary to Caly Sell, Deputy Secretary, Meeting Minutes.
LMI. May 6, 2005. Duf_6 Conversion Project CD-2 Corrective Action Plan Review.
LMI. October 2005. Duf_6 Conversion Project CD-3 Corrective Action Plan Review.

Waste Treatment and Immobilization Plant, (2012:01-D-416)
$5,781 billion, Status: Red
Hanford Site
Federal Project Director: John Eschenberg
Data:
Logistics Management Institute (LMI). April 2002. External Independent Review, CD-3B of the Waste Treatment and Immobilization Plant Project.
LMI. September 2002. External Independent Review Independent Cost Review CD-3C Review of the Waste Treatment and Immobilization Plant Project.
LMI. March 2003. External Independent Review Follow-up Review of the Waste Treatment and Immobilization Plant, Out Briefing.
U.S. Army Corps of Engineers. May 2004. Independent Cost and Schedule Baseline Review, Summary Report.

Waste Stabilization and Disposition Projects
$14, 216.3 billion, Status: Yellow/Green
Savannah River Site
Federal Project Directors: Doug Hintze and Kevin Smith
Data:
Burns and Roe. December 2004. External Independent Review of the Savannah River Site EM Cleanup Lifecycle Baseline.
Department of Energy (DOE). December 2004. EM Cleanup Project Lifecycle Baseline External Independent Review Corrective Action Plan.
DOE. February 4, 2005. Memorandum from Robert McMullen, Acting, Director, Office of Engineering and Construction Management to Paul Golan, Director, acting director Office of Environmental Management. Validation of Near Term Baseline.
Burns and Roe. October 2005. EM Cleanup Project Lifecycle Baseline External Independent Review Corrective Action Plan; Recommended Path Forward to Close Out Responses to Findings.

C
Summary Notes of a Workshop on DOE EIRs

The DOE External Independent Review Workshop was conducted June 8, 2006, at the Keck Center of the National Academies, Room 203, 500 Fifth Street, NW, in Washington, D.C. The agenda and list of workshop participants appear at the end of this summary.

The Committee on Assessing the Results of External Independent Reviews for U.S. Department of Energy Projects conducted a fact-finding workshop to solicit comments and opinions from DOE staff, including project directors, program and project management support managers from the Office of Engineering Construction and Management (OECM) and the program secretarial offices (PSOs) Operations and Management (O&M) contractors, and external independent review (EIR) contractors. The workshop consisted of open discussions to address a series of questions regarding the planning and execution of EIRs, EIR reports and corrective action plans, the value of EIRs, and suggestions for improving EIRs in the future.

The following summarizes the discussion based on notes taken by Michael Cohn, NRC program officer. The summary reflects the comments of the participants but is not a verbatim transcript. The comments were interpreted and condensed so as to allow focusing on the issues being considered by the committee. The sources of the comments are identified by job title or affiliation to provide context.

PLANNING AND IMPLEMENTING REVIEWS

Tailoring

Committee: Please comment on the process used to plan EIRs, the people involved in planning, and if the reviews are effectively tailored to the conditions presented by individual projects.

Federal project director (FPD): EIRs definitely need to be tailored. Each review should take into account the maturity and type of project being reviewed. New capital construction projects are different from a continuing operation or new baseline in a continuing acquisition. The 16 elements in the EIR guideline can be used, but the emphasis needs to be adapted to the project. It is important that the reviews be planned with the federal project director (FPD) as an active participant. The planning process also needs to recognize that the projects continue to mature as the EIR planning proceeds. Documents are given to the review team 5 weeks before the review, but they are not static. A lot of communication between the project team and the review team is needed to keep the review team current. The project team's involvement is also needed to guide the preparation of on-site briefings.

Program/project management support office (PMSO) manager: It is important for the review team to recognize the implications of the various types of contracts used by DOE. A cost plus incentive fee contract is very different from a fixed-price contract. In the latter type of contract, the contractor bears the risk and the role of the EIR changes. The EIR for a specific project should reflect how risk is identified and quantified and what roles DOE staff and contractors play in managing risk.

Planning Process

FPD: There does not seem to be a clear process for FPDs to become involved in planning and tailoring the EIRs, nor is there a way to ensure that the FPD's concerns are addressed by the review.

OECM: The planning process has evolved in the past few years with increasing participation of the FPDs. Nonetheless, OECM has the final say on the scope of the EIR, which is intended to support validation of the baseline, and serves as an assessment of the readiness of a project to proceed. The process varies depending on the OECM, program, project, and contractor personnel involved. The intent is to have a collaborative process.

Program/PMSO manager: The Office of Science (SC) recently issued a directive that all EIR planning should be approved by the PMSO. SC will require agreement on the scope, review team, and costs before providing funds for the review. This had been discussed in the past, but the procedure had not been clearly defined. In the past, SC relied on the site office to ensure the quality of the EIR but was not sufficiently involved in the planning decisions. The process needs to be more collaborative than it has been. We need to assess the objective of the EIRs and focus more on the baseline cost and schedule and less on compliance with the details of acquisition policy.

Small Projects

Program/PMSO manager: The SC laboratory infrastructure program undertakes many projects that are significant (generally from $5 million to $20 million), but relatively small and less complex when compared to the new capital acquisition projects in SC. In some cases, tailoring has been applied to these small projects, eliminating the on-site portion of the review and relying solely on the review of documents and conference calls. These so called "desk-top reviews" do not work.

The EIRs are of value to these projects not only as a validation of the baseline but also as a means to transfer lessons learned and develop the knowledge and abilities of the junior project staff who are routinely assigned to the smaller projects. Even with the proposed shift in the lower limit for mandated EIRs to projects costing more than $100 million, we would like to continue conducting EIRs for selected laboratory infrastructure projects.

OECM: Proposed changes to O 413.3 for projects less than $100 million will allow either OECM or the program office to manage the review. OECM will provide the contract for employing the EIR contractor, but PSOs programs will be responsible for selecting the contractor and planning the review.

EIR contractor: EIRs provide exposure to lessons learned on past projects and training opportunities for less experienced project directors assigned to the smaller projects. This opportunity could be lost if reviews are not conducted for projects with less than $100 million total estimated cost (TEC).

OECM: Reviews will continue to be required, but they will be the responsibility of the program or site office. They will have the latitude to use either internal or external reviews.

M&O contractor: There is value in having an independent review, even for smaller, less complex projects. In the past, however, some of the reviews were too detailed for simple infrastructure projects, with the same EIR process having been used for them as for large new construction projects.

Program/PMSO manager: There has often been a cookie cutter approach to planning EIRs. They are all treated the same and follow the same lines of inquiry and the same level of detail regardless of the size and complexity of the project. OECM insists that scope is not negotiable, because the independence of

the review would be compromised if the program or project teams were allowed to have significant influence on the scope of the review. The result of this insistence has been ineffective tailoring.

Review Criteria

Committee: If program offices were responsible for determining if an EIR is needed, what criteria would they use?

Program/PMSO manager: The complexity of the project would be the primary criterion. The experience of the project team would also be important.

Committee: Should EIRs for smaller projects include all the current lines of inquiry? Should the emphasis be on baseline validation or project manager development?

Program/PMSO manager: Baseline validation is the primary purpose. Most infrastructure projects are developed as design-to-budget projects, and DOE needs to know that what is proposed can be accomplished for the allotted budget.

Program/PMSO manager: If O 413.3 is revised as proposed, the project management support office in SC will conduct independent reviews of all projects with TECs between $5 to $100 million, including laboratory infrastructure projects. The reviews will be tailored to critical issues presented by each project. They will look at the technical design issues, cost and schedule baselines, and, most important, the readiness of the management team. Past EIRs focused more on compliance with procedural requirements and less on the effectiveness of the management team.

EIRs Versus IPRs

Committee: Will SC continue to conduct EIRs for projects under $100 million TEC or rely solely on IPRs?

Program/PMSO manager: SC believes that reviews conducted by SC personnel who are not affiliated with the project are independent. SC will primarily use IPRs and only use EIRs as needed.

Program/PMSO manager: One of the problems with past EIRs is that the review team did not know enough about the project or the technical issues. A review team is definitely independent, but that is not enough to add value to the project.

Program/PMSO manager: The previous statement describes what happened during the course of several SC projects, particularly those involving highly technical physics experimental systems.

Committee: How do the Office of Environmental Management (EM) and the National Nuclear Security Administration (NNSA) anticipate conducting reviews for projects with a TEC of less than $100 million?

Program/PMSO manager: The change in the dollar value threshold is not likely to have much of an impact on EM since most EM projects are greater than $100 million TEC. EM conducts IPRs that are similar to SC's reviews prior to the EIRs and independent of the EIR approximately every 9 months. The IPRs rely on EM staff from headquarters and field offices and on consultants.

Program/PMSO manager: NNSA conducts IPRs prior to CD-1 and CD-3 (except for major systems, when OECM conducts EIRs). If the threshold is changed to $100 million TEC, NNSA will be conducting more IPRs for baseline validation prior to CD-2. IPRs primarily use NNSA personnel from other sites. Contractors are used if the needed expertise is not available in NNSA.

FPD: I have found NNSA IPRs to be very helpful.

Program/PMSO manager: NNSA will conduct an IPR when issues arise and the project team determines that it needs outside review and input.

Review Teams

Committee: For projects with a TEC greater than $100 million that will continue to have EIRs planned by OECM and executed by contractors, is there a need to pay more attention to the technical subject matter experts on the review teams?

Program/PMSO manager: Having a review team with the necessary technical experts is a critical issue for SC. Because of the specialized nature of SC projects, this expertise is difficult to find outside SC. The Liniac Coherent Light Source (LCLS) project is an example of the kind of project where a lack of expertise on the review team can cause delays and reduce the effectiveness of the EIR.

Committee: Could SC, or other program offices, work with OECM to identify the experts that need to be on a team without infringing the independence of the review?

EIR contractor: The EIR contractors bring experts to the review teams to address technical issues and would include specific expertise if so encouraged by DOE. In some cases, particularly joint IPR/EIR reviews, the contractors have been told not to provide the expertise because the areas requiring that expertise would be addressed by DOE.

EIR contractor: Most of the contractor's EIR personnel are independent experts who are called in as necessary to take on the issues presented by a specific EIR assignment. Contractors generally respond to OECM suggestions.

Coordination of EIRs and IPRs

Committee: What are the factors that determine the extent of coordination, sharing of expertise, and joint activities for IPRs and EIRs and if the reviews are conducted sequentially or concurrently?

Program/PMSO manager: Joint sessions with open meetings and breakout sessions are an effective model.

EIR contractor: Problems can arise because the IPR and EIR teams are competing for the same project resources to conduct their reviews, but this can be overcome with sufficient planning and coordination.

Committee: Do joint IPR/EIR reviews blur the lines of accountability for the outcome of the review?

EIR contractor: The juxtaposition of two teams with separate leadership increases the challenge of coordinating the review agenda and arriving at recommendations.

Program/PMSO manager: Joint IPR/EIR reviews generally share data and conduct simultaneous briefings but each team develops it own report and recommendations.

EIR contractor: Reviews have included a combination of joint and separate sessions that are focused on the needs of each project. This variety of arrangements provides an opportunity to share project resources and individual observations.

EIR contractor: The EIR and IPR teams often focus on different aspects of a project; e.g., an EIR might focus on cost and schedule and an IPR on scope. Because project outcomes are determined by the interaction of these issues, each team needs to be aware of the changes being recommended by the other. Conducting the reviews simultaneously makes coordination more difficult.

Committee: Are reviews planned and coordinated for the life cycle of a project?

Program/PMSO manager: In addition to the reviews set by DOE policy, individual program offices plan project review schedules independently to support their needs.

Committee: Does DOE plan on using the same review participants through the entire life of the project or does it plan to adjust the expertise in response to changing project issues?

Program/PMSO manager: IPR teams selected by the program offices do try to balance continuity and the changing needs of the project.

Committee: If the IPR addresses scope and the EIR cost and schedule, is it helpful to the EIR team if there is an IPR prior to the EIR?

EIR contractor: Yes, it is necessary to set the scope before the cost and schedule can be validated. Generally, if an IPR has been conducted, the results are available to the EIR team. The EIR team does not undertake a technical design/scope review but verifies that one has been completed and outstanding issues have been resolved.

Committee: It appears that EIRs and IPRs are conducted either concurrently or consecutively. What are the advantages or disadvantages of these two approaches?

Program/PMSO manager: For a large project, concurrent EIR/IPR reviews are less disruptive and require less of the project team's time.

FPD: Consecutive reviews benefit the project team because the IPR can serve as a high-level review, identifying issues that can be corrected before the EIR. It can also be used to help focus the EIR so that it is more effective.

Program/PMSO manager: Consecutive reviews offer more learning opportunities for less-experienced project managers. The cost of an EIR is not insignificant. Conducting an IPR before the EIR facilitates assessment of the readiness of a project for baseline validation.

Program/PMSO manager: IPRs also cover readiness issues not covered in EIRs, such as safety and management concerns. Neither approach is clearly better. The best approach is determined by the circumstance of the project and the surrounding issues.

EIR contractor: Every EIR is tailored. They cover the same 16 lines of inquiry but to varying levels of detail. They may appear similar on the surface, but they are all tailored to the issues presented by the project.

Committee: An effective IPR should identify outstanding issues; the EIR would then only verify that they had been resolved. Is an EIR effective if it does not find any issues that were not identified and resolved?

OECM: We have never come across such a case, but the answer is yes. The goal is to validate the baseline, not find mistakes.

Committee: Is the timing of IPRs and EIRs properly distributed in the life cycle of a project? Does the timing support continuous process improvement?

Program/PMSO manager: We would hope there is continuous process improvement and we would hope that at some point we get good enough at project management that we will need fewer reviews.

Lessons Learned

Committee: Does the current program of reviews have a mechanism to capture lessons learned from one project and transfer them throughout DOE?

OECM: There is currently no DOE-wide lessons-learned system for project management. Some of the programs have undertaken initiatives to identify and distribute lessons learned.

Program/PMSO manager: NNSA is developing a lessons learned database by mining past IPRs. NNSA also conducts workshops where project managers share the successes and problems experienced on various projects.

Peer Review or Audit

Program/PMSO manager: The EIR process was established to ensure senior managers that policy and procedures are being followed and that project management outcomes meet a vaguely defined level of quality. The EIRs are like audits while the IPRs are more like a peer review. The audience for the first EIRs was Congress. Reports were sent directly to the appropriation committees. The audience has shifted more to DOE senior managers, but Congress is still watching. EIRs are becoming more like peer reviews, but they are still considered by field staff to be audits.

Committee: How can that staff perception be changed?

Program/PMSO manager: Changing that perception will be difficult because people from the outside the PSO are viewed as adversaries because the customers for an EIR are the OECM, the senior management, and Congress, not the PSO. The reviews are not being conducted for the PSO's benefit. The external perspective is important for the larger projects but it creates an adversarial atmosphere between the PSO, the OECM, and the EIR contractors.

FPD: FPDs do not feel that they can influence the scope or focus of the EIR.

EIR contractor: From our point of view, OECM is the customer. Although it is clearly beneficial to involve the program and project in the planning process, that is not the way planning is being done. From the contractor personnel's perspective, OECM determines the scope of the review. If others are involved in the planning process, there needs to be one DOE person who can resolve conflicts that may arise. We try to overcome the perception that the EIR team members are auditors, but the limited involvement of program and project personnel in the planning process makes that more difficult.

Planning Process

OECM: There should be broad participation from the project and program in the planning process. In some cases the PMSOs choose not to participate. OECM needs to ensure that the scope of the review will allow verifying the baseline. The quality of communications in the planning process depends on the people involved in a project.

Program/PMSO manager: Neither the planning process itself or the roles of the program and project in planning EIRs are clearly defined. In one case the program and project took the initiative to define the scope of the EIR, which then became the basis for discussions with OECM and the contractor. The results were very productive.

EIR contractor: For a recent project, the contractor developed a review plan, which was then distributed to OECM, the program, and project for comments. It was revised and all parties signed off on it before the site visit. This seemed to provide sufficient communication for a relatively straightforward project.

EIR contractor: The 16 elements in the lines of inquiry are fairly inclusive. Most of the tailoring involves the attention to various details within these elements.

Committee: It appears the current process does not work for mega projects. Are alternatives to the EIR, such as U.S. Army Corps of Engineers (USACE) reviews and project-contractor-led "best and brightest" reviews, more appropriate for mega projects?

Program/PMSO manager: EM is seeing good results from the "best and brightest" approach at CD-1 to ensure that projects are well defined from the beginning. This should make EIRs more effective at CD-2. For EM, many of the issues relate to environmental safety and health (ES&H).

OECM: We probably should put more emphasis on CD-1. If the project plan and structure are fully aligned at that point, the project will be more likely to have a valid baseline at CD-2.

OECM: We need to separate the need for external, fully independent peer reviews from the mission assigned to OECM—that is, to validate the baselines.

Independent Cost Estimates

Committee: There does not appear to be much reference to independent cost estimates (ICE) as a part of the current review process. Are they still used?

Program/PMSO manager: There is a role for them, but it is not well defined in O 413.3. After not conducting ICEs for a while, we are just starting to do them again. The USACE is doing one for the Hanford Waste Treatment and Immobilization Plant (WTP) project, but that is an exception.

FPD: The value of the ICE depends on the specific circumstances of a project.

Program/PMSO manager: EM has cost-estimating capability in house.

Committee: What are the current criteria for ICEs?

Program/PMSO manager: An ICE is a bottom-up cost estimate. This is different from a cost review or a government estimate. Generally DOE does not have a lot of cost data or cost estimating capability. We need independent input. ICEs are generally not part of EIRs.

EIR contractors: EIRs usually include a focused independent cost review (ICR) that reviews cost estimating assumptions for selected work packages. A bottom-up estimate is usually a major undertaking that is too intensive to be part of an EIR.

Assessing the Management Team

Committee: Can an EIR evaluate the adequacy of a project management team?

OECM: Yes. They do that by evaluating the performance of the project team.

EIR contractor: The EIR usually does not address the qualification of individuals, but will usually comment if a potential problem is observed.

Program/PMSO manager: The EIR teams often comment informally about the performance and potential performance of the project team.

Program/PMSO manager: The government spends a lot of time and effort in source selection and does not need an EIR to second guess its source selection by evaluating the contractor's project management team.

Program/PMSO manager: The management capabilities of the project team are critical. Judgments about their ability to execute the project need to be an internal matter. The EIR can identify potential problems, but responsibility for determining if a change is needed stays with the department.

EIR contractor: The O 413.3 and the EIR directives have not been adapted to design-build projects. The project management requirements and the EIR process need refinement. Reviews need to be incorporated into the project management plan.

Value of On-site Reviews

Committee: Do EIRs need to include on-site reviews or can they be accomplished off-site by conference calls and a review of documents?

EIR contractor: The value of face-to-face meetings and seeing the job site is difficult to know, but that direct contact definitely helps an EIR team evaluate the project. Some parts of a review can be done off-site but they need to be focused.

FPD: For large projects, the EIR team definitely needs to be on-site.

EIR contractor: It is not ideal, but when necessary, individual members can participate from a distance. The goal should be to have the entire team on site.

DOCUMENTATION OF REVIEWS AND CORRECTIVE ACTION PLANS

Review Findings and Recommendations

Committee: What is the best way to communicate the outcome of a review to the project team and the OECM?

EIR contractor: Generally there is an open session briefing by the EIR team at the end of the on-site review. The session brings together the project team and other contractors and DOE personnel involved in the project. People who are not at the site are linked by phone. View graphs are prepared and distributed the night before. The session includes time for discussion. The EIR team then prepares a written report, which is transmitted to OECM about a week after the on-site review. OECM reviews the report to determine if it is ready to send to the site office. The project team reviews the report for factual accuracy. The final report includes an outline of recommendations for the corrective action plan (CAP). It is an iterative process.

OECM: We have also conducted some EIRs where the final report was submitted before the team left the site. This approach is still being evaluated.

EIR contractor: For a large project whose review may take several weeks, there are periodic briefings of findings rather than a single briefing at the end of the review. This allows the project team to resolve most issues before the review team leaves the site.

Committee: The term "corrective action plan" may have negative connotations. Would it help if such plans were called "action plans" or "follow-up plans"? The new terminology might also change the false perception that an EIR is an audit.

OECM: That issue has never come up.

EIR contractor: The report sometimes includes appendixes that identify best practices that the project team could use to improve the management of the project.

Program/PMSO manager: In reality, the review team does not always follow this process. When the program office or project team does not agree with the EIR team the process gets bogged down. Generally, there is insufficient attention paid to the project team's perspective. There should be an option that allows the project team to disagree with the review findings.

EIR contractor: The reports have three levels of findings. Only the most significant findings require corrective actions. The project team can disagree and ignore the less important findings and still have the project baseline validated. In the end, it is up to OECM to determine what actions need to be taken to validate the baseline.

Committee: Is there a problem with review teams adding findings to the final report that were not discussed at the site briefing?

Program/PMSO manager: If the review team cannot identify all the major findings before they leave the site, they are not doing their job. The project team needs an opportunity to discuss the outcome of the review and, if necessary, voice objections.

EIR contractor: Issues that arise after the site briefing are discussed with OECM. The FPD may also be brought into the discussion. There is no set procedure for communicating additional findings.

Corrective Action Plans

Committee: What happens to CAPs? Are they tracked beyond validation of the baseline?

Program/PMSO manager: CAPs are implemented immediately. Some of the responses are ongoing and will continue until the end of the project.

OECM: In some cases a plan of action is sufficient; in others, the plan needs to be completed or implemented. OECM needs to determine, based in part on its judgment, when to validate the project.

EIR contractor: Many of the recommendations address the cost and schedule issues that should be addressed before validation. By segregating the recommendations into three levels of importance, the review reports also sets priorities for action. The significant findings are generally those that need to be addressed before the baseline is validated. The EIR contractor is providing recommendations, but it is up to OECM to determine what is required from the project before it is allowed to proceed and up to the program to determine what requires long-term attention.

VALUE OF EXTERNAL INDEPENDENT REVIEWS

Committee: Is there a sense that EIRs result in a better outcome for a project?

Program/PMSO manager: A project is generally improved by conducting IPRs and EIRs, but it is difficult to determine if the benefit comes from the project team's preparation for the review or the review itself. Anticipation of a review increases the rigor of the project team's planning and documentation.

Program/PMSO manager: In some instances the EIRs did not identify any issues that the program and project team were not already aware of. The concept of the EIR is valuable, but the implementation does not always provide the anticipated value. Problems have occurred when communications falter and EIRs address issues that are not germane to the project. For SC, an IPR is more productive. The relative importance of the standard 16 lines of inquiry can vary greatly from project to project. The review team does not always identify which issues are critical and which will not affect the outcome of the project. The EIR is not a substitute for effective project management. SC tries to have a transparent process so that OECM should know beforehand if an EIR project is ready to proceed. EIRs do not add value that is consistent with their cost.

Program/PMSO manager: Projects receive benefits from EIRs, but there is a question about their value and if the benefit justifies the cost. The program offices pay for the EIRs. Since 1999 DOE has expended more than $50 million on EIRs. NNSA is spending $5.3 million this year, which is more than four times PMSO's budget to provide IPRs, training, and other activities that are needed to ensure effective project management. That is why we question the value of EIRs. They need to be done, but they should be limited to the large projects where they can make a difference. The cost of an EIR is probably offset by reduced project costs, but that money is not available for the other activities that need to be done to improve project management. From a program perspective, an IPR provides much greater value.

Committee: There was earlier reference to a lessons learned program to increase the benefits gained from reviews. Does that apply to EIRs?

Program/PMSO manager: That was an NNSA program that applies to IPRs only. It could be used for EIRs.

Committee: Why are EIRs not funded out of project funds?

Program/PMSO manager: DOE policies determine the funding sources. EIRs will be funded through the working capital fund (WCF) starting in FY07. Programs will contribute operating dollars to the WCF to pay for the reviews.

Committee: Are the projects required to conduct IPRs?

Program/PMSO manager: IPRs are only required prior to CD-3. Most IPRs are done at the discretion of the PSO.. SC performs IPRs more frequently than the other programs. NNSA conducted 35 IPRs last year that were requested by the FPD or the program office. EM conducts IPRs prior to CD-1 and then through CD-3.

Committee: Could IPRs replace EIRs?

Program/PMSO manager: Not entirely, especially for the larger projects and for the program offices that do not have PMSOs.

Committee: What is the average cost of an EIR?

Program/PMSO manager: The average cost is approximately $150,000. One recent EIR cost $1.2 million.

EIR contractor: EIRs for smaller projects with a three-member review team cost approximately $50,000.

Committee: The rate at which projects were rebaselined drove the need for EIRs. Has project performance been improved by conducting EIRs? Could internal reviews achieve the same results?

OECM: The complexity of the issues and number of external factors affecting project performance make it difficult to measure the impact of reviews.

EIR contractor: There are examples of projects that have been canceled based on EIR findings. Here, EIRs clearly provided a benefit.

O&M contractor: For one fairly large but not complex project, the EIR identified approximately 20 issues; however, none of them were of any consequence. There are also examples of projects that underwent several EIRs before the project progressed to the point that it could proceed past CD-2.

Program/PMSO manager: Benefits are definitely gained from conducting EIRs, but they should be limited to larger projects that have the potential to embarrass DOE. It is easy for an EIR or IPR to provide significant results when it is applied to projects that are known to be in trouble. The challenge is identifying the precursors of those problems and applying corrective action before the problems arise. It is also more difficult to assess the impact of preventive actions that result in cost avoidance as opposed to cost savings.

Committee: Does a project that experiences problems after an EIR and acceptance of the CAP mean the EIR and the validation process have failed?

Program/PMSO manager: Every successful project and every problematic project has had an EIR or IPR. The question is not the type of review but whether or not it addressed the critical issues. Sometimes the critical issues were not identified, sometimes the risks could not be avoided, and other times external requirements, such as the design basis threat, are not known at the time of the review. The interval between reviews can contribute to the impact of all these scenarios. There are instances when problems arose because the designs were not ready for construction or the project team did not understand the bidding market, but the IPRs and EIRs did not assess those aspects of project management.

Committee: Should the review team have recognized these issues as a threat to the project baseline?

OECM: We see evidence that in some instances the EIRs need more rigor, but at the same time there are pressures to reduce the cost of reviews.

EIR contractor: The EIRs are an evolving process. They used to be conducted in greater depth and included larger samples. Cost pressures have led to reduced scopes and smaller samples. The challenge is to identify the critical projects.

Committee: Is the fact that a project has not undertaken an IPR or EIR for an extended period of time a leading indicator of management problems?

Program/PMSO manager: It could be a sign that the process is not open or transparent.

Committee: Does the value of an EIR depend on employing the right EIR contractor for the project, and how can that contractor be identified? Is there a process to assess the capabilities of the various EIR contractors?

Program/PMSO manager: Yes, the experience and expertise of the review team are critical to the success of the review. The programs give OECM feedback on the quality of review teams, but the process is informal.

OECM: A more formal assessment process is under development.

Committee: How are the contractors selected?

OECM: The program offices are asked if they have a preference, but OECM has the primary responsibility for selecting the contractor. Factors such as previous experience at a site, expertise, and current workload are used to select from the group of contractors with multiyear indefinite quantity contracts. We just added two additional contractors to the group for a total of five, which seems to be sufficient.

Committee: Do the contractors receive enough feedback to help them improve future reviews?

EIR contractor: Contractor performance is reviewed annually by OECM, but there is no feedback on particular projects.

OPPORTUNITIES FOR IMPROVEMENT

Committee: Could the composition of the EIR team be improved by including people designated by DOE as having the required expertise? Would DOE's involvement in selecting the team interfere with the contractor's control of the EIR?

EIR contractor: Using DOE-designated participants on the review team is not a problem as long as they have no conflict of interest, i.e., no prior or future involvement in the project. Each member of the team contributes to the final review report, but the contractor controls the content of the final report. The externality of the review would be compromised and its independence could be questioned. However, DOE's participation in the selection would be appropriate if it was necessary to obtain the necessary expertise. The final judge of the independence of the review is OECM.

OECM: We try to keep it as independent as possible, but the objective is to obtain a review team that is both informed and independent.

EIR contractor: Members of the review team are relied on to maintain their professional integrity.

Committee: Could project outcomes be improved or costs reduced with better coordination of IPRs and EIRs?

FPD: If sufficient time elapses between the IPR and the EIR they can form a complementary iterative process. The key is timing. There are examples where this has worked.

OECM: The EIR team is informed of the outcome of prior reviews, which helps the team to better focus its review.

Committee: Is there a more efficient method for conducting EIRs and completing the review report?

EIR contractor: Giving the contractor more lead time improves selection of the review team and planning of the review. The cost of the review may not be reduced but it will be more effective.

OECM: For some NNSA reviews, the review team was kept on site until the report was completed. This reduced the time required to complete the report, but it increased the cost and presumably did not affect the quality of the review.

EIR contractor: It generally takes about a week to develop a draft EIR report. This seems to be a reasonable time and applies whether the report is written on-site or back in the office. Because the reports and the review team briefings are preceded by dialogue between the review team and the project team, the final briefing and report should not hold any surprises for the project team. The review benefits somewhat from having time to reflect and putting some distance between the review team and the project site.

EIR contractor: OECM has developed a guide for the reports that facilitates the writing process and makes the reports more consistent.

Committee: During the project reviews the committee heard that early planning and close coordination with the project team, on-site participation of OECM, and discussion of preliminary findings led to an effective review. Is there anything to add to this list?

OECM: Pre-EIR site visits also seem to increase the effectiveness of the reviews.

Committee: Would projects benefit more from reviews (both IPR and EIR) if they were conducted periodically rather than prior to CDs?

Program/PMSO manager: SC tries to conduct reviews on a 6-month schedule but also tries to schedule them ahead of CDs. A 6-month interval is typical after construction starts. Reviews are also conducted when performance issues arise. Reviews for NNSA and EM projects are not as frequent or regular.

Committee: Are there any concerns about the proposed changes to O 413.3 that will eliminate the requirement for EIRs for projects with TECs of less than $100 million?

EIR contractor: Contractors are not unhappy about this change because there will continue to be a sufficient workload. They have seen improvement in DOE project management activities that may be the result of the EIRs. If the IPRs are implemented for projects with TEC less than $100 million and project managers continue to be held accountable, then this improvement should continue. Some form of review will continue to be needed.

New Issues

EIR contractor: The reviews are conducted when the design is approximately 30 percent complete. The review focuses primarily on cost and schedule to deliver the scope as defined at the time of the review. The review does not verify that the scope is accurate, and subsequent baseline changes are often the result of changes in scope that are implemented during completion of the design. Should the EIRs be delayed until the design is more complete and the scope becomes fixed?

Committee: A scope can be clearly defined at that point in a project when design is 30 percent complete. Lack of a clear scope is a failure of project management. An assessment of the completeness of the scope definition should be part of the EIR.

Program/PMSO manager: DOE has adapted a project definition rating index (PDRI) tool developed by the CII. The tool helps project managers determine if the scope has been defined sufficiently to allow the project to proceed. It is used by EM and NNSA for IPRs prior to CD-1.

OECM: The EIR should occur when the project is ready to be baselined. If the scope is not defined, the project is not ready. If the design needs to be more than 30 percent complete before the scope can be fixed, then the project probably should wait. The need to have a well-defined scope is often ignored because various external budget or political pressures make it urgent to start the project.

Following a call for final comments, the workshop was adjourned at 4:00 p.m.

WORKSHOP AGENDA

June 8, 2006

8:30 a.m. **Welcome and Introductions**–Joseph Colaco

Objectives of the Study and the Workshop–Michael Cohn

9:00 a.m. **Workshop Discussions**–Gary Sanders, committee member, workshop facilitator

Planning and Implementing EIRs

- Are EIRs planned effectively to address the project issues that have the greatest impact on the performance baseline?
- Are the reviews tailored consistently, or is there evidence of inconsistent response to project conditions?
- Who should be responsible for tailoring the review?
- Should EIRs be tailored by adjusting duration, team expertise, issues/project management documents reviewed, or other aspects?
- Should EIRs be tailored to program requirements (i.e. a different starting point for each program) and then tailored to the specific project requirements?
- Are there a limited or infinite number of approaches?
- Are EIRs carried out with some consistency?
- Do EIR teams have all of the necessary expertise and experience? Which types of expertise and experience are missing? Which are not necessary?

- Is there a separate role for an independent cost estimator? Should an ICE be part of an EIR or separate?
- Is the time needed to complete a review consistent with the complexity and importance of the issues motivating it?
- Can EIRs be effective without on-site activities?
- Are CAPs developed, communicated, and implemented effectively? Are they (or should they be) part of the project management system and tracked beyond validation of the baseline?
- Does the involvement of multiple parties (e.g., OECM, program HQ, DOE project personnel, contractor's project personnel, EIR contractor) lead to communication problems?
- Are the current 16 elements in the EIR Standard Operating Procedures document appropriate? Are there elements that should be included in all reviews? Conversely, should some elements be considered in exceptional circumstances only?
- Is there (or should there be) a follow-up to improve future EIRs, and are such follow-up findings used?
- Do the advantages (e.g.., knowledge of DOE procedures and expectations for EIRs) of using a limited number of EIR contractors outweigh the disadvantages (e.g., risk of losing independence)?

12:00 p.m. **Lunch**

1:00 p.m. **Documentation of EIRs and Corrective Actions**

- Is the review plan formulated jointly by the program office, the OECM, the review contractor, and the project team documented sufficiently? Do all parties have a clear understanding of the EIR objectives?
- Are results of EIRs communicated effectively at the time of the site visit and, in written documentation?
- Do review reports produce findings characteristic of an audit, checklist review, and/or a substantive analysis?
- Is there a way to collect and transfer EIR lessons learned?
- Are there continuous project and program records of all reviews (IPRs, EIRs, etc.), CAPs, and corrective actions? Are these data tracked and compared to project performance?

2:00 p.m. **Determining the Value of EIRs**

- Do reviews consistently produce findings and recommendations that impact (improve or reduce risk) the project baseline cost, schedule, and scope, and risk management and project management strategies?
- How often are EIR findings and recommendations of little or no consequence?
- How often are there problems in projects that should have been identified and corrected during an EIR?
- Do projects that experience problems after CD-2 indicate a weakness in the EIR?
- Do projects that follow the performance baseline indicate an effective EIR?
- Does an EIR finding that a project has no problems or issues have value?
- Do project directors/managers value the output of EIRs?
- Do project directors/managers benefit from preparing for EIRs?
- Is preparation for a pre-CD-2 EIR the same as preparation for CD-2? Does preparation for the EIR make it easier to prepare for the CD review?

- Which elements of the EIR provide the greatest benefit to the project team and management?
- Is the value gained from an EIR consistent with its direct and indirect costs?

3:00 p.m. **Break**

3:15 p.m. **Opportunities for Improvement**

- Are there more effective and efficient alternative methods for validating performance baselines?
- Can reviews be made more effective by including personnel from other government agencies on the review teams?
- Should EIR review teams include DOE personnel from other programs? Is there sufficient support from senior DOE managers to facilitate cross-program reviews?
- Can EIR contractors be encouraged to include others and still be held responsible for the outcomes?
- Is it more effective to review some issues/documents (e.g., WBS, risk management plan, cost and schedule estimates) with an IPR or EIR?
- Can an equivalent outcome be accomplished with a smaller, more limited, or more numerous reviews?
- Would increased coordination between IPRs and EIRs increase the effectiveness of both?
- Should EIRs be used for more than CD-1 alternative finance, CD-2 performance baseline validation, rebaseline validation, and CD-3 readiness for major systems projects?
- There is a proposal to raise the lower limit of the cost of a project that will require an EIR to $100 million. Is this appropriate starting point? Should it be higher, or should some form of EIR be used for projects with smaller TECs?
- Should there be a point where EIRs managed by OECM are no longer necessary, or necessary only for major systems acquisition or large complex projects?

4:15 p.m. **Observations and Conclusions**

4:30 p.m. **Adjourn**

PARTICIPANTS

In addition to the NRC study committee, the following Department of Energy (DOE) staff, M&O contractors, and EIR contractors participated in the workshop:

David Arakawa, DOE, Office of Science*
Terence Bates, Systematic Management Services, Inc., M&O contractor
Kevin Bazzell, DOE, Office of Environmental Management, Richlands Operations Office
Kin Chao, DOE, Office of Science
Raymond P. Chuebon, Burns and Roe, EIR contractor
A. Scott Dam, Logistics Management Institute, EIR contractor
Mike Donnelly, DOE, Office of Engineering and Construction Management
Joe Eng, DOE, Office of Science*
Gregg Flett, Oak Ridge National Laboratory, M&O contractor*
Geoff Greene, Oak Ridge National Laboratory, M&O contractor*
Mike Hickman, DOE, National Nuclear Security Administration
Linda Horton, DOE, Oak Ridge National Laboratory*

Jeff Hoy, DOE, Office of Science*
Tom Hull, DOE, Office of Environmental Management
Thad Konopnicki, DOE, National Nuclear Security Administration
Jim Krupnick, Oak Ridge National Laboratory, M&O contractor*
Dan Lehman, DOE, Office of Science
Katy Makeig, DOE, National Nuclear Security Administration
Caryle Miller, DOE, Office of Science
John "Bill" Newton, Jupiter Corporation, EIR contractor
Jeanette Norte, DOE, National Nuclear Security Administration, Sandia *
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Brian Kong, DOE, Office of Engineering and Construction Management
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Jay Rhoderick, DOE, Office of Environmental Management
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Lisa Saldano, DOE, Office of Engineering and Construction Management
Jehanne Simon-Gillo, DOE, Office of Science
Jack Stellern, Oak Ridge National Laboratory, M&O contractor*
Chris Watson, Project Time and Cost, EIR contractor
Gerald W. Westerbeck, Logistics Management Institute, EIR contractor

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* Participated by phone.

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Acronyms and Abbreviations

CAP	corrective action plan
CD-0	critical decision 0, approval of mission need
CD-1	critical decision 1, approval of alternative selection and cost range
CD-2	critical decision 2, approval of performance baseline
CD-3	critical decision 3, approval of start of construction
CD-4	critical decision 4, approval of start of operations or project closeout
CII	Construction Industry Institute
DOE	U.S. Department of Energy
EIR	external independent review
EM	Office of Environmental Management
IPR	independent project review
IPT	integrated project team
M&O	Management and Operations (contractor)
NNSA	National Nuclear Security Administration
OECM	Office of Engineering and Construction Management
PARS	Project Analysis and Reporting System
PMSO	project management support office
PSO	program secretarial office
SC	Office of Science
TEC	total estimated cost
TPC	total project cost